THURSDAY NOVEMBER 28, 1895.

THE "TIMES" ON THE SCIENTIFIC SITUATION.

WE rejoice that at last the daily press is beginning to see the necessity of the State action which we have been preaching for some years to prevent as far as possible the ruining of many of our industries threatened by the development of scientific research and processes in other countries.

Yesterday the *Times* spoke out with no uncertain sound in connection with the often repeated cases in which, in various foreign markets, English are being replaced by German goods. The paragraph to which we refer runs as follows :—

"Our Berlin correspondent called attention two days ago to the immense strides made by German industry during the last quarter of a century, and to the failure of our Government to pay any adequate attention to a development so closely concerning British interests. In this commercial age this industrial nation has one commercial Attaché in Paris who is supposed to keep an eye upon all Europe, and one at St. Petersburg who has all Asia for his province. A commercial Attaché at Berlin for Germany alone would find ample occupation and would furnish knowledge of things that deeply concern us, which it may be feared neither the Government nor the mercantile classes of this country possess at present. We also require urgently a commercial Attaché with especial qualifications for the Far East. Yesterday our Paris correspondent informed us that on his first appearance as Minister for Foreign Affairs M. Berthelot asked money for the establishment of six new consulates in China. The contrast is sufficiently striking between the policy of the two countries, and the difference runs through the entire treatment of the material interests of the two peoples. Both in Germany and in France it is held an essential part of the duty of the State to second, and not only to second, but to stimulate and direct the efforts of private enterprise. In this country, though State interference with commerce is being carried to a dangerous length, State assistance, even in the way of collecting information, is regarded with stupid distrust and disfavour. Our home industries themselves in many cases languish for want of intelligent direction. Our agricultural distress might be alleviated were the State not far above the education of the population in the minor agricultural arts, and the organisation of agricultural industries after the manner in vogue on the Continent. In the same way, although nothing can excuse the short-sighted folly of our manufacturing classes in not providing for scientific research in the various branches of industry, yet it is the duty of a wise Government to take measures to counteract the folly of classes when it threatens the general interest. In one word, Great Britain stands at this moment in imminent danger of being beaten out of the most lucrative fields of commerce, simply because it does not recognise, while other nations do, the value of scientific organisation in the field, in the workshop, in the laboratory, and in the conduct of national policy."

The development of this question at the present moment, on the very day when the public meeting to promote a memorial to Huxley was held, reminds us how much we have lost—how much weaker we are for his absence. Never was Huxley more emphatic than when he pleaded, years ago, for the organisation of our scientific forces, so as to secure the victories of peace. It is now certain that we have lost many of these peaceful battles, and that we shall lose more, because our legislators have either not read the signs of the times, or have been led by those who, if they were consistent, would bring back our Navy to its state in Queen Elizabeth's time, when it was the outcome of individual and local effort.

It is encouraging to think that when the attention of the commercial classes has been drawn to what is happening, as it must be before long, and when the public will possess full knowledge of the utter chaos of our public departments in all things appealing to the national life, so far as it depends upon commercial enterprise under the existing conditions, some action must be taken. We have Committees of the Privy Council for this and that and the other departments, but where are the Scientific Privy Councillors? Where are the meetings held at which they give the State the benefit of their knowledge? In what record do we find the minutes of such "My Lords" as these?

It is not fair even to the administrators of the several departments that the present state of things should be allowed to exist. Too few of these have been chosen on account of their scientific knowledge, and as each question arises they have to pick up their information as best they can. There are several ways of doing this, one of them exhibited by the Board of Trade inquiry last week into the revised regulations referring to the Electric Lighting Acts. The Conference showed conclusively how much the Department gained by the free imparting of knowledge by outsiders.

But this is only one direction in which reforms are needed. The Chambers of Commerce throughout the country must sooner or later take the matter up; and when this is done, many other ways of abolishing the existing chaos will suggest themselves. Some of them we may refer to on a subsequent occasion.

EARTH-WORMS AND STREAM-WORMS.

A Monograph of the Order of Oligochæta. By F. E. Beddard, M.A., F.R.S. Pp. 769, 5 plates, and woodcuts. (Oxford : Clarendon Press, 1895.)

IT seems, at first sight, somewhat curious that such common animals as earthworms, occurring as they do all over the globe, should have received so little attention from zoologists until recent years : yet the neglect is not really to be wondered at, for earthworms are very much alike, and are only distinguishable from one another with difficulty even by a zoologist, while to the non-scientific traveller, collector or settler—to whom students of other classes of animals owe so great a debt—earthworms present no attractive character of form, and rarely of colour. Their subterranean habits, too, protect even brilliantly coloured, or specially large, species from the keen eye of the collector. Some of these worms reach a length of four feet, others are less than an inch ; whilst most are uninterestingly coloured, there are some bright ones. *Megascolex cæruleus* is a beautiful peacock blue, *Microchæta rappi* is olive green, and pink below.

Notwithstanding their general unattractiveness, it might have been expected, however, that professional zoologists would have been acquainted with the anatomy of foreign earthworms long before the Franco-Prussian war ; yet the first description of the internal organisation of a worm, recognised as being different from our European earthworms, only dates from 1868. About the time of this war, M. Perrier was preparing an account of the anatomy of nine new genera from various parts of the world, which were in the museum at Paris. After the publication of this memoir, in 1872, we have a gap of more than ten years, ere the number of foreign genera was increased ; then, in 1883, Mr. Beddard described *Typhæus* from India. But from 1880 onwards, a constantly increasing number of contributions to the anatomy of the group has been published, so that, while in 1884 the bibliography in Prof. Vejdovsky's valuable monograph contains 283 references, that just published by Mr. Beddard refers to more than 650 memoirs.

In the handsome monograph under notice, Mr. Beddard treats his subject in a different manner from that followed by the Bohemian naturalist, who, to a very great extent, confined himself to those species which had come under his own observation. The present author, however, while bringing together facts collected by himself during the past fifteen years, deals fully with the researches of other zoologists. Vejdovsky paid more special attention to the aquatic forms ; Beddard gives an adequate account of the entire group of Oligochæta. His work opens with a clear and excellent account of the general anatomy of the group, an account not overburdened with unnecessary detail, but yet containing discussions on many important points of morphology. This chapter should be of the greatest value to the general zoologist, who has long been in need of such an authoritative summary ; for the group usually receives but scant attention from him, as after a detailed account of the anatomy and development of the British earthworm (to which, by-the-by, he frequently gives a wrong name), he leaves the rest of the earthworms as if they were not. Yet at least seventy-five genera of earthworms are known, some of which contain 100 species ; and even in Britain we have as many as sixteen species, belonging to four genera.

In this anatomical chapter the author gives a very detailed and comparative account of the structure usually known as "prostate" or "atrium," which is generally connected with the end of the sperm duct ; he suggests the term "spermiducal gland," which is in every way a useful and distinctive name. These structures have already received discussion at the hands of himself and others, and in the present book he essentially agrees with a view put forward by myself some time ago, though he misunderstands my views as to the Eudrilidæ. He is wrong in his statement that there is no peritoneum surrounding the "cement gland" of Tulificids, for I have figured this in the case of *Heterochæta*. He adopts the view, in which I quite agree, that the spermiducal glands have been derived from structures, such as occur in *Microchæta* and *Kynotus*, entirely independent of the sperm duct, with which they have, in most cases, become secondarily connected.

The monograph, unlike Vejdovsky's, gives a diagnosis of every known species of Oligochæta, both aquatic and terrestrial, which has been described in sufficiently recognisable terms ; consequently, the book is invaluable to the specialist and to museum curators. The only member of the class which we miss is that peculiar leech-like parasite on the gills of crayfish, *Branchiobdella*. This has long been recognised as an Oligochæte, and it is not clear why Mr. Beddard has omitted it.

The chapter dealing with the classification and phylogeny of the group contains much that is of interest, and is by no means the "dry bones" that a systematic work frequently is. The class is divided into three "groups" of equal value (1) : the Aphanoneura, for the genus *Æolosoma;* (2) the Microdrili, or aquatic worms and Moniligastridæ ; (3) the Megadrili, or earthworms. Each of the latter "groups" (to which he does not give a technical term) he divides into families, some of which are grouped to form "superfamilies." But I cannot altogether agree with him in this primary subdivision. It is true that in 1890 (*Quart. Jour. Micr. Sci.*) I suggested the terms, Megadrili and Microdrili, much in the same sense as he uses them ; but more recently I have been led to adopt Vejdovsky's opinion, viz. that all earthworms (except *Moniligaster*) form one family, and are to be contrasted with each (not all) of the families of water-worms. Beddard endeavours (on pp. 158 and 171), rather laboriously, it seems to me, to define these two "groups," but the Moniligastridæ have always been a stumbling-block, and Prof. A. G. Bourne's recent memoir (*Quart. Jour. Micr. Sci.* xxxvi.) tends to emphasise rather than to diminish the difficulty ; for the clitellum of *Moniligaster*, on which Beddard lays much stress, is there described as being quite like that of an earthworm, and not like that of a water-worm.

Mr. Beddard's careful analysis of the affinities of the various families to one another, and, in later chapters, of the inter-relations of the genera, is a distinctive feature of this monograph, and he calls to his aid the facts from geographical distribution to support his contention that the Perichætidæ are the most archaic earthworms. The primitive arrangement of the bristles in earthworms was

according to him, a circle round each segment; by reduction, the more usual number, eight, has been brought about. He refers to *Anisochæta* (which, by-the-by, we find on turning to the systematic part of the work, only a synonym for *Megascolex* sp.), a perichæte with only eight bristles on the anterior segments, as a step in this process, which in certain normal octochætous forms, may go so far as to cause the entire disappearance of bristles from the anterior segments. Since the monograph was in press, Prof. Bourne has published (*Quart. Journ. Micr. Sc.* xxxvi.) an account of the development of the bristles in the embryo of *Perichæta*, which rather tends to support the view, that the primitive number was eight, and that the perichætous condition is due to the appearance of additional bristles; and the fact that a circle of bristles occurs in another family of earthworms, as well as in certain Polychætes, also makes against Beddard's views.

Another phylogenetic point of special interest is that of the nephridia. Beddard and others have held that the "plectonephric" or "micronephric" condition is antecedent to the "meganephric"; but the ontogeny of three distinct genera contradicts this view, which Beddard, evidently with reluctance, now gives up. I quite agree with him and others, that my group "Plectonephrica" is artificial.

But while regarding the perichætous condition as archaic amongst earthworms, he places at the base of the whole Oligochæte tree (p. 173) a genus, *Phreoryctes*, in which there are usually only *four* bristles in each segment. Mr. Beddard recognises the difficulty of his position, but does not meet it in a very convincing manner. The facts of the geographical distribution of the earthworms are of great general importance, for the worms and their cocoons will not withstand prolonged immersion in sea-water, and modes of transference are few; the cocoons, being buried deep in the earth, are not likely to be carried on the feet of birds. "The characteristic earthworms of New Zealand are Acanthodrilids; the same family is equally characteristic of Patagonia and the adjacent islands; the only known earthworms from Marion and Kerguelen islands belong to the genus *Acanthodrilus*. These facts seem to me to be sufficiently important to require the formation of an antarctic region circumpolar in extent"—though it would not necessarily include the Cape. Australia is more closely allied to the oriental region (p. 154) than one would have suspected.

We may heartily congratulate Mr. Beddard on this able and readable monograph which he has found time to write, in addition to publishing many papers on other subjects in connection with his work as Prosector to the Zoological Society; and we may also offer our thanks to the Clarendon Press for undertaking this work. The book consists of 725 quarto pages of text, together with 85 pages of bibliography, and a full index (from which, however, we miss *Anteus*); there are five lithographed plates, and numerous illustrations in the text; it is well printed, with wide margins, and simply but effectively bound. But, while offering our congratulations, we must also record a grumble; for there are one or two omissions which detract from the usefulness of the work, from a systematist's point of view. (1) A tabular statement of the classification adopted, would have rendered his views more clearly and more readily than having to weed it out of the text; (2) a synopsis of differential family characters in tabular form, such as we find in the recent Catalogues of the British Museum, would enable one to refer an earthworm to its family with comparative ease. Tables of generic characters there frequently are; but they are often so ill-arranged as to be of comparatively little use. Some of these tables extend across two entire pages of fifty lines or more, and it is extremely difficult for the eye to follow these lines across the wide margins of the two pages (pp. 532–533), especially when, as in p. 632 of my copy, the pages are so bound that the lines do not correspond. This matter might have been so easily remedied by numbering the lines on each page.

Lists of the genera recognised as good, are usually given after the discussion of the family characters; but in some cases, as in Perichætidæ, the list does not appear.

The number of plates seems very inadequate to the text, and it is not evident what plan has been followed in selecting the species figured to illustrate the vascular system, for example; for not one of the figures pretends to give a complete plan of the system, and the chief types even are not represented. Plate v. will remain a mystery to many readers. The diagrams of the reproductive organs, which are on the plan adopted by me in my "Attempt to Classify Earthworms," might have been, with advantage, increased in number so as to include every family.

Such interesting matters as the encysted *Æolosom*, and the peculiarly modified genital setæ of Acanthodrilids, might well have been illustrated.

In such an extensive work as this, misprints and smaller errors can scarcely be excluded, but they are very rare; nevertheless, we think that all measurements should have been given in the metrical system. Here and there one finds "inches" cropping up (*Geoscolex maximus*); and sometimes, where the original measurements were in inches, the transformation to millimetres has been worked out wrongly (*Plagiochæta*).

But with all its faults, the monograph redounds to the credit both of the author and the publishers, and is a most welcome addition to our zoological standard works.

W. B. BENHAM.

DYNAMICS.

Dynamics. By P. G. Tait, M.A., Sec. R.S.E. Pp. 361. (London: Adam and Charles Black, 1895.)

THE main substance of Prof. Tait's present work has, for the past twelve years, been accessible to any one who cared to be at the trouble of consulting the cumbrous volumes of the "Encyclopædia Britannica," but we are glad that the author has at last been induced to issue his article on "Mechanics" in the form of a compact and handy octavo volume. This will be a useful addition to the library of every teacher who has to lecture to advanced classes, but the very encyclopædic treatment of the subject makes it rather hard to judge how far Prof. Tait's work meets the requirements of students. The author

himself says in the preface that "in teaching, I have found it advantageous to supplement the work at each stage by additional examples of the processes given in the text; as well as by references to special books in which particular questions are examined with greater detail." Considered as a synopsis of the principles of statics, particle and rigid dynamics, hydrodynamics, and even portions of elasticity, the book may safely be recommended either to mathematical students, or to such students of physics or engineering as have undergone the necessary preliminary grounding in higher analytical methods.

In its new form, Prof. Tait's "Dynamics" might be not inaptly described as a "Thomson and Tait for Beginners," and in scope and plan it is not very different from Ziwet's American treatise on "Theoretical Mechanics." It opens with a short introductory chapter on Newton's laws, followed in chapter ii. by over 80 pages devoted to pure kinematics, under which heading the analysis of strain receives a fair share of attention. Chapter iii. opens with a few further definitions relating to the laws of motion, chiefly extracted from "Thomson and Tait," followed by an outline of statics of a particle and the theory of attractions, including Green's theorem and the method of electrical images; the whole being condensed into 36 pages. Chapters iv. and v. deal with particle kinetics, and include 14 pages on the principle of least and varying action, and 6 pages on Lagrange's generalised equations. Statics and kinetics of a rigid body follow next, then a short chapter on the dynamics of a chain, in which vibrations of strings occupy only 7 pages. After this comes a still shorter chapter containing a few of the simpler applications of the theory of elasticity. In chapter x. the fundamental equations of hydrodynamics are disposed of in 25 pages, and are followed by a chapter on waves, based on Prof. Tait's "Encyclopædia" article on the subject. The author concludes with a short philosophical discussion on the "objectivity of force."

Unlike the ordinary run of text-books, this one contains no collections of examples, but in most of the worked-out problems, only the main results are stated, so that the reader will find plenty of work to do in filling up the gaps. Perhaps this plan will afford as good or better training than the usual routine of "bookwork and riders." There is a further advantage in the elimination of unnecessary formulæ from the text. The judicious use of small type has also done much in making the mathematical portion appear less formidable, and the use of dark type has been avoided by adopting the method of indention.

A reviewer naturally turns his attention sooner or later to the sections which deal with the laws of motion, and these cannot be said to be above criticism. The recognition of Newton's scholium to the third law as a separate dynamical principle is good, but we should have been glad to have seen greater definiteness in dealing with the second law. We all know that "quantity of motion" is to be interpreted as momentum, but Newton makes no mention of *time* in his statement, and modern text-book writers have remedied the deficiency by restating the second law in the following three different ways:

(1) *Rate of* change of momentum is proportional to the force.

(2) Change of momentum *in a given time* is proportional to the force. (In other words, change of momentum varies as the force when the time is kept constant; the fact that it varies as the time when the force is kept constant, being regarded as too obvious to require stating as a law.)

(3) Change of momentum is proportional to the *impulse* of the force, *impulse* being defined as the time-integral of a force.

Now, Prof. Tait appears to regard the law from the second standpoint on page 8, and from the first on page 100, and yet reference to the "Principia" suggests that the third interpretation is the most strictly Newtonian, since Newton evidently regarded *force* as capable either of being impressed gradually, or of being concentrated about a single instant of time. A statement of Prof. Tait's real views would have been far more acceptable than the series of definitions of "change of momentum," "rate of change of momentum," "rate of change of kinetic energy," "space-rate of change of it," with which chapter iii. opens. If a *rate* had been defined generally, these definitions would be superfluous.

In § 118 we are told that "the second law gives us the means of measuring force, and also of measuring the mass of a body." We had always thought (and still think) that the *third* law is required before *both* force and mass can be measured. For in comparing two forces, Prof. Tait supposes them applied in turn to the same body. But this test affords no criterion of the equality of two forces when applied to different bodies, as they have to be in comparing the masses of the bodies. If we assume an independent definition of equal forces (as, for instance, in Prof. Tait's illustration on p. 111, where he assumes that the same locomotive exerts approximately the same pull on two different trains), the second law, of course, affords a means of comparing two masses, but not otherwise.

We are sorry that Prof. Tait has not altogether banished from his book that highly misleading and artificial phraseology of "a point having several simultaneous velocities" in connection with the parallelogram law (§ 117). Combined with the definition of *velocity* as "rate of change of position," this always *seems* to suggest the (absurd) notion that the point moves into, and therefore occupies, different positions at the same instant. All that the parallelogram of velocities really proves, and what Prof. Tait proves in §§ 30, 31, is that if the velocity of A relative to B and the velocity of B relative to C are represented by two sides of a parallelogram, the diagonal represents the velocity of A relative to C. In passing from this to the parallelogram of forces, the discontinuity of reasoning could perhaps be overcome by a reference to Newton's commentary on his second law, which states that the effect of several forces is the same whether they be impressed simultaneously or successively.

In § 108 the author defines as "the 'component' of a force in any direction" what is now, with great advantage, usually called the *resolved part* of the force in that direction.

We should also like to see the use of the word "stress" avoided in connection with Newton's third law (§§ 174, 352), until some definite understanding has been arrived at as to whether the term is to signify a force, or (like

pressure) a quantity of the dimensions of force divided by area; but, after all, we have had to put up with ambiguities of this kind for so long, that the matter is of no great consequence to the class of readers for whom Prof. Tait's useful little book is intended. G. H. B.

OUR BOOK SHELF.

The People of the Moon. By Tremlett Carter. Pp. 402. (London: The *Electrician* Printing and Publishing Co., Ltd., 1895.)

THIS remarkable book bears upon every page evidence of scientific knowledge and vivid imagination. It is not simply a story of a journey to our satellite—that idea has been worn to threads since Jules Verne used it for the ground-plan of his novel—but purports to be a translation of a volume written by a lunar inhabitant, and sent to the earth. More than one ingenious individual has sapiently suggested that the side of the moon remote from us is inhabited; and as we are not likely to obtain any information on the matter, every one is free to indulge in that belief. The idea that there are living beings in the moon's interior, is of a similar harmless character, and the author of this book has made the most of it.

Down in the interior of the moon, and near the centre, dwelt a race of people—the Sarâva—who believed that the universe was an illimitable extent of solid rock, honeycombed throughout with endless tunnels and caverns. But a man arose—a lunar Copernicus—who propounded the doctrine that the place which the Sarâva occupied was merely a lump of cavern-hollowed rock suspended in an infinite vacant space. Urged by a vision, a Prince of the Sarâva sets out with two companions in the hope of reaching the surface, and their expedition is successful. With the adventures of the explorers, we have nothing to do, nor is it for us to analyse the sentimental undercurrent. The attractive parts of the story, from the scientific point of view, are those which show the author's acquaintance with electromagnetic waves and the ether. He makes the Sarâva possess machines to etherealise matter, so that by having two powerful electromagnetic foci at any distance apart, it was possible to transmit objects or people from one to the other with the velocity of light; the object being etherealised at one focus, projected to the other, and then by a similar series of electromagnetic waves converted into its material state. Having reached such a high state of knowledge of the ether, it is hardly necessary to say that the Sarâva could see and speak with one another at a distance, without the necessity of connecting wires, and had also managed to tap the ether and use its terrific energies in destructive weapons. How very intelligently, and with what regard to known facts these imaginary machines are constructed, can only be appreciated by a perusal of the book. We congratulate the author on the skilful and original way in which he has handled an old subject.

Frail Children of the Air. Excursions into the World of Butterflies. By Samuel Hubbard Scudder. Pp. 279. Nine plain plates. (Boston and New York: Houghton, Mifflin, and Co. London: Gay and Bird, 1895.)

IT might be supposed from the title of this book, that it was wholly popular, and that entomologists would find little to attract their attention in it; but this would be a great error, for it is really a collection of thirty-one philosophical essays on butterfly and caterpillar life, reprinted, with additions and modifications, from Dr. Scudder's great work on the "Butterflies of New England." Many subjects of great interest and importance are touched upon, relative to the modes of protection of butterflies in all their stages: fossil butterflies; the origin of the present butterfly fauna of North America; the habits of butterflies, caterpillars, &c. One of the most interesting chapters is, perhaps, that relating to the butterfly fauna of the White Mountains of New Hampshire, where butterflies appear to swarm to an extent which the richest localities in Europe could perhaps hardly parallel in number of individuals. Dr. Scudder does not confine his remarks to American species, however, but has also looked up the European literature bearing on his subject very thoroughly, as, indeed, was only to be expected from an entomologist of his industry and energy. Here and there, however, we may detect a casual oversight, as where *Iphiclides podalirius*, L., is spoken of as "confined to the Mediterranean region" (p. 247), when it is really found throughout the greater part of Central Europe as well. Occasionally, too, Dr. Scudder's information can be supplemented, as when in speaking of ants attending the larvæ of *Lycænidæ*, he omits the instances which have been recorded of some Australian species (*Hypochrysops delicia*, Hewitson, and *Ialmenus evagoras*, Donovan, &c., see Anderson and Spry's "Victorian Butterflies," pp. 94, 98, 99). Incidentally various subjects of more general interest are remarked upon, as where Dr. Scudder agrees with Desor (p. 250) in attributing the greater intensity, both of butterfly and of human life in America, as compared to Europe, to the much greater vicissitudes of climate in the former country; or when, in more than one passage, he agrees with Wallace and others, among our deeper-thinking naturalists, that the workings of natural selection are incomprehensible unless we regard them as guided by a controlling intelligence. W. F. K.

The Story of the Earth in Past Ages. By Prof. H. G. Seeley, F.R.S. Pp. 196. (London: George Newnes, Ltd., 1895.)

PROF. SEELEY tells the geological story of the earth in an orderly, though not strikingly luminous, manner. Beginning with evidence of the earth's internal heat, he passes to the materials of mountain chains, and then to the consideration of volcanic rocks. With reference to the latter section, it seems to us that his descriptions of the compositions of rhyolites, trachytes, andesites, and basalts are more suitable for a text-book than for a book intended for popular reading. In fact, Prof. Seeley has too exalted an idea of the knowledge of the general public, who, we are afraid, will not be able to understand a large part of his little book. Few of his unscientific readers will have any idea conveyed to them by remarks such as follow: "The bivalve shells are usually species of *Cyclas*, or *Unio*, or *Anodonta*. The univalve shells are either the pond shells *Planorbis*, *Paludina*, and *Limnæa*, or such river shells as *Neritina*, and the freshwater limpet." Similar instances of the use of technical nomenclature without explanation could be quoted from almost every chapter in the book.

The materials of stratified rocks form the subject of the fourth chapter, and then, after short descriptions of the succession of strata, the origin of stratigraphical geology, and fossils, the formations are treated in order, from the Archæan rocks to glacial deposits and gravel beds. Within the compass of less than two hundred small pages, it has only been possible for Prof. Seeley to indicate a few of the features of the different rocks. Thus, the chapter on Archæan rocks consists of three small pages, and would only fill about a column of NATURE, and there are other chapters just as scanty. Most of the figures are very badly reproduced, and there is no index; so that, altogether, we do not regard the book as a very satisfactory one.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Remarkable Sounds.

In a book that was popular about fifty years ago, entitled "Journal of a Naturalist," the author says that the purely rural, little noticed, and, indeed, local occurrence, called by the country people "hummings in the air," was annually to be heard in fields near his dwelling. "About the middle of the day, perhaps from twelve o'clock till two, on a few calm sultry days in July, we occasionally hear, when in particular places, the humming of apparently a large swarm of bees. It is generally in some spacious open spot that this murmuring first attracts our attention. As we move onwards the sound becomes fainter, and by degrees is no longer audible." The sound is attributed to insects, although they are invisible.

A writer in the *Edinburgh Philosophical Journal* objects to this sound being attributed to insects, first because the fact is stated as being local and partial, heard only in one or two fields, at particular times of the year when the air is calm and sultry. He has often heard a similar humming in a thick wood, when the air is calm, and has diligently searched for insects, but in no case was able to detect them in numbers sufficient to account for the sound.

The same writer refers to remarkable sounds heard in a range of hills in Cheshire. When the wind is easterly, and nearly calm on the flats, a hollow moaning sound is heard, popularly termed the "soughing of the wind," which Sir Walter Scott, in his glossary to "Guy Mannering," interprets as a hollow blast or whisper. The explanation seems to be that a breeze, not perceptible in the flat country, sweeps from the summit of the hills, and acts the part of a blower on the sinuosities or hollows, which thus respond to the draught of air like enormous organ-pipes, and become for the time wind instruments on a gigantic scale.[1]

The greater intensity of sounds by night is ascribed by Humboldt to the presence of the sun acting on their propagation, by opposing them with currents of air of different density, and partial undulations of the atmosphere, caused by unequally heating different parts of the earth. In these cases, where the air suddenly changes in density, the vibrations which produce the sounds are divided into two waves, and a sort of acoustic mirage is produced in the same manner as a luminous mirage takes place from a similar cause. But there are, probably, other causes connected with the presence or absence, excess or diminution of solar heat, of moisture, &c., which may operate both in the increase or continuance of sound; while many peculiarities of place or season may create or modify certain sounds, which being local, admit only of special explanation.

The distances to which sounds sometimes travel are remarkable. Dr. Clarke, the traveller, states that, while 100 miles from the Egyptian coast, he heard firing therefrom, the air being very still at the time. Dr. Arnott mentions a case in which bells were heard at a similar distance by a ship off the coast of Brazil.

In Madame de Sévigné's gardens at Les Roches, near the town of Vitré, details have been given of an echo of so wonderfully multiplied a character, that rather than describe them, I prefer to ask for further information.

In another book, popular half a century ago, namely, "Forest Scenes," by Major Head, there is a description of sounds emitted by a sheet of ice fifteen or sixteen square miles in area, and three feet thick, when acted on by the wind. "A dreary undulating sound wandered from point to point, perplexing the mind to imagine whence it came, or whither it went, and whether aërial or subterranean, sometimes like low moaning, then swelling into a deep-toned note, as produced by some æolian instrument." C. TOMLINSON.

Highgate, N.

The Story of the "Wandering Jew."

So far as my scanty reading goes, I have never met with a book on the subject of the "Wandering Jew" making mention of an Indian tale in this connection, and I therefore deem it more or less useful to call attention of the folk-lorists to the following Buddhist narrative, for which I have to thank Mr. Seisaku Murayama, an assiduous Pâli scholar in Japan, who was kind enough to make a journey in my behalf with the sole intention of personal examination of the Chinese text. The passage occurs in "Tsah-ö-han-King" (*Saṃyuktâgama-sûtra*, translated by *Guṇabhadra*, *circa* A.D 435–443), printed in Fuh-chau, 1609, tom. xxiii. fol. 30, and may be translated thus:—[This is a portion of an answer of Pin-tau-lu (= *Piṇḍola Bharadvâga*?) to the question of the King As'ôka.] "And further, when the Buddha was staying in the kingdom of S'râvasti with the five hundred arhats, the daughter of the *Śreshṭhin* Anâthapiṇḍada happened to live in the kingdom of Fu-lau-na-poh-to-na (= Pundara-varddhana?), and invited thither the Buddha and the monks. All other monks then, went gliding through the air; but I, exerting my supernatural energy, held up a huge mount and there went. Then the Buddha accused me with these words: 'Wherefore do you play such a miracle? for which offence I now punish you with eternal existence in this world, incapable of the reach to Nirvâṇa, thus to guard my doctrine against its destruction.'" KUMAGUSU MINAKATA.

15 Blithfield Street, Kensington, W., November 22.

Dr. Baur and the Galapagos.

In my article on Dr. Baur's botanical collections from the Galapagos (NATURE, vol. lii. p. 623), I stated that he was attached to the U.S. Fish Commission steamer *Albatross*. This was an error. Dr. Baur's trip was quite independent of Government aid, and was accomplished mainly through the liberality of two or three private gentlemen. So far as I can learn, there are no botanical results worth mentioning of the United States Government expedition.

I may add that Dr. Baur informs me that he is planning another visit to the Galapagos group, when he hopes to explore the Revilla Gigedos, Clipperton, Cocos, and Malpelo Islands; but that it cannot be carried out for two or three years to come. The natural history of all these islands is still very imperfectly known. The naturalist of the expedition of H.M.S. *Sulphur* brought home specimens from Cocos Island, about fifty years ago, of a dozen or more flowering plants, indicating no special insular differentiation from common tropical American types.

W. BOTTING HEMSLEY.

A Bright Meteor.

We have received the following letter through Mr. R. H Scott, F.R.S., Secretary of the Meteorological Council:—

On returning home from sending you my sunshine telegram, this evening (about 7 p.m.) I witnessed the most superb meteor of my lifetime. The best conception I can give of it is to ask you to imagine a gigantic iron bar stretching over, I should say, one-eighth of the whole sky, and glowing as the wire glows in the incandescent lamp. It was almost at the zenith, and came from the east-north-east to the west-south-west. The glow remained for certainly one second, if not more time, and then slowly changed through all the colours of the spectrum, before finally disappearing. I should imagine it was seen over a large extent, and more must be heard of it. I assure you I esteem myself most fortunate to have witnessed a spectacle more magnificent than any before observed by me, although I witnessed the display of November meteors in 1866.

Eastbourne, November 22. R. SHEWARD.

A Long Drought.

In connection with Brückner's prediction of a dry period culminating at this time, and the letter of Prof. J. P. O'Reilly in NATURE of October 17, the following account of a general drought from a Boston newspaper of November 11, may prove of interest. H. HELM CLAYTON.

Blue Hill Observatory, November 12.

"The long drought, which has caused so much inconvenience and damage this fall, seems to have prevailed all round the world, if not in every part of it. Europe has experienced it almost equally with this country, and in Australia it has been more severe than here. So great was the distress in New South Wales, that the Government appointed a Sunday in September as a day of prayer for rain, and special services in accord with the proclamation were held in all the churches of every denomination in Sydney and throughout the province. The drought occurred in the Antipodean spring, and greatly retarded planting operations, as well as doing great general damage. In many districts

[1] In the *Annales de Chimie et de Physique* for 1840 is a valuable paper, by M. Fournet, on "Hill and Valley Breezes."

the grass was literally burnt off the earth, and the mortality among stock was great. The railway trains carried supplies of water from lakes and rivers to all stricken points along the lines, selling it at the rate of twenty-five cents a thousand gallons. The water supply of many towns entirely failed, the inconvenience experienced was acute everywhere, and many agriculturists were ruined.

"All through our own South the drought has been remarkable in its length, and some odd situations have occurred. In Kentucky the beds of many streams that have never before been dry are now full of dust, the mud having become baked hard, and then broken by the wind. At Uniontown, Kentucky, the Ohio was so low that an old coal vein under the river-bed was worked, and thousands of bushels of coal were taken out. In many places along the Ohio, Mississippi, and other streams, old wrecks have been uncovered by the lowering of the water, and the residents along the banks have recovered lots of more or less valuable cargo and junk. At Milton, Kentucky, there is a large sandbar on which many a barge of coal has struck and foundered. This bar was entirely uncovered recently, and the people living near by went to work with ordinary field ploughs and turned up tons of coal. In Maine and other eastern States the drought has been severe. The ice crop promises to be short, because lots of lands have gone almost dry, and there is no water to freeze. These general conditions have existed all over the continent, and in the north-west the situation is as bad as in the east and south."

The Pressure of a Saturated Vapour as an Explicit Function of the Temperature.

IN NATURE (October 24), Mr. Donnan observed that the "Law of Diameters" in combination with any equation of state, such as Van der Waal's, which applies to the region of coexistence of liquid and vapour, supplies an (empirical) expression for the maximum pressure of a vapour at any temperature T in the form of an explicit function of this temperature and known constants.

Led by the same thought, I have found the equation for the vapour tension.

The "Law of Diameters," in combination with the law of Maxwell-Clausius and the equations:

$$\zeta_1 + \zeta_2 + \zeta' = 3\zeta_c$$
$$\zeta_1\zeta_2\zeta' = \frac{p}{ac}$$

{ζ_1 = density of the liquid, ζ_2 = density of vapour, ζ' = density lying between ζ_1 and ζ_2 (labile state)}

gives me

$$p = \mu\frac{(T - T_0)^3\left(\frac{T_c}{T_0} - \frac{T_0}{T_c}\right)}{\frac{3T_c}{T} - \frac{4T_0}{T_0}}$$

{T_0 = temperature, at which the tension of vapour is nil.}
T_c = critical temperature.

The method of Mr. Donnan gives:

$$p = 3p_c e^{1 - \frac{T}{T_c}\left\{\frac{24}{27}\frac{T - T_0}{3T_c - 2T_0 - T} - \frac{(T - T_0)^2}{(T_c - T_0)^2}\right\}}.$$

If the "Law of Diameters" were consistent with the equation of state, the formulæ would be the same. G. BAKKER.

Schiedam, Holland, October.

Metallic Resistance and Radiation.

A RESULT published by Dr. Aschkinass, to the effect that the electrical resistance of thin metallic sheets like tinfoil is affected by the impact of radiation (electric waves), is often quoted; but, so far as I know, it has not been confirmed. My own experience tends to disprove it; but if any one has succeeded in confirming it, perhaps they would give us the benefit of the information. It is easy, of course, to get spurious effects with bad joints, in accordance with the discovery of Branly; and I see in your "Notes" (p. 60) to-day, that a Japanese experimenter, Mr. Mizuno, is of the same opinion.

November 22. OLIVER J. LODGE.

"L'Arithmétique Amusante."

IN the review of the above book (NATURE, November 7), mention is made of the curious fact that $8 \times 123456789 + 9 = 987654321$. It may be of interest to point out that this is not an isolated numerical curiosity, but is, I find, one of a group of similar curiosities which are included in the following easily proved theorem.

If the number formed by writing down in ascending order beginning with unity the first n digits of any scale whose radix is r be multiplied by $r-2$, and n be added to the product, the result is equal to the number formed by writing down in descending order the last n digits of the scale beginning with the last. WILLIAM LUCAS.

MR. LUCAS'S theorem is quite correct: the cases for $r = 10$ have been given by E. Lucas in his "Théorie des Nombres," i. p. 28, as well as (if I remember rightly) in the "Arithmétique Amusante." M. E. Lucas was probably acquainted with the general theorem; whether he published it, or whether it has ever been published, I cannot say. G. B. MATHEWS.

Upper Bangor, November 19.

The Society of Medical Phonographers.

THE address of Dr. Gowers on "the art of writing in relation to medical and scientific work," delivered to the Society of Medical Phonographers, which was mentioned in your issue of August 8, and was published in the *British Medical Journal* for October 7, has been reprinted by the Society. There are a few spare copies, and any scientific worker, who is interested in the subject, can obtain one by sending a penny stamp to Mr. Wm. Holmes, printer, Ulverston.

It may be of interest to state that the number of members of the Society is now 202. I shall be glad to know the name of any scientific worker who uses shorthand.

JAMES NEIL, Hon. Sec.

Warneford Asylum, Oxford, November 22.

THE ROYAL COMMISSION ON SECONDARY EDUCATION.

IT would be difficult to produce a document more typically English than this Report, dated August 13, 1895, of the Royal Commission appointed on March 2, 1894, "to consider what are the best methods of establishing a well-organised system of secondary education in England, taking into account existing deficiencies, and having regard to such local sources of revenue, from endowment or otherwise, as are available, or may be made available, for this purpose, and to make recommendations accordingly."

That our country does not possess even an approach to a system, let alone a *well-organised* system, of secondary education, is in itself a sufficiently remarkable circumstance; but some may think it even more remarkable that, having recognised this, a task so difficult as that before the Royal Commissioners should have been entrusted so recently as last year to persons who, however worthy individually, as a body but very imperfectly represent the vast interests involved in such an enquiry. More than a quarter of a century has now elapsed since the publication of the report of the Schools Enquiry Commission appointed in 1864, and in the interval science has not only advanced with giant strides, but has also been applied to industrial purposes to an extraordinary extent, with the result that a revolution has taken place affecting not only all our actions, but our very modes of thought also, and requiring us to take cognisance of many entirely novel conceptions and considerations. Meanwhile also, our national prosperity has received a most severe check through the competition of those who have been quicker than ourselves to avail themselves of scientific discoveries and methods of working: and the probability is great that such competition will rapidly increase in severity and become unbearable unless we, as Huxley said, "organise victory"—to do which, however, we must march very fast, as we have both to overtake those who are already far ahead of us, as well as go quickly when we come up with them. It was therefore imperative that in considering the organisation of

secondary education, we should fully take into account and avail ourselves of the teachings of science. And it is consequently just cause of complaint that only a single representative of science—Sir Henry Roscoe—should have been placed on the Commission.

NATURE may also well object to the limited construction put by the Commissioners upon the reference submitted to them—that they should have understood it to so confine their enquiries as to lead them to think that it was not their function to include either an examination and description of the instruction now actually given in secondary schools, or a consideration of what subjects it ought to cover, and by what methods it should be given; and that consequently they should have mainly restricted themselves to what they call the external or administrative part of the subject. This, to the ordinary mind, is not unlike leaving out of account the weapons used in modern warfare, as well as all questions of tactics, in considering the organisation of our defensive and offensive forces; as education must in the future be the arsenal in which our weapons both of defence and offence will be mainly fashioned, the parallel can scarcely be said to be wanting in appositeness. It is all the more remarkable that the Commissioners should have taken so narrow a view, as on the second page of the Report they say that the object they had before them was nothing less than to complete the educational system of England, now confessedly defective in that part which lies between the elementary schools and the Universities.

Among those who have studied the conditions of English education and compared it with the best foreign systems, who are aware of the state of English public feeling on such matters, and who also take into account the altered conditions under which we now live and work, the impression is strong, however, that nothing is more wanted here than a clear declaration of policy which would serve to form public opinion and lead it into the right direction as regards the character of education most suited to the times. Although confessedly a practical people, we continue to allow our children to receive an education bearing little relation to the practical needs of life; the reason being, probably, that we do not sufficiently recognise that we owe our success almost entirely to innate good qualities, and that Englishmen have been helped in a comparatively small degree in what they have done by their school training.

It should have been easily within the powers of the Commissioners to have properly discussed such questions, and it is surprising that it should have been found difficult "to secure the help of those who, while not directly or professionally connected with secondary schools, had studied educational problems." And besides hearing witnesses belonging to the class of "educational statesmen and thinkers," workers might perhaps have been listened to with even greater advantage—when the theoretical evidence tendered by some is contrasted with that of an accomplished and experienced worker like Miss Beale, for example, there is no difficulty in deciding which is the more valuable. If also the opinions of a few experienced instructors at the universities and elsewhere, who have to do with large numbers of average students from secondary schools, had been invited, material would have been accumulated of importance in determining our future educational policy, and which probably would have led the Commissioners to open their eyes very widely: information as to the previous places of education of undergraduates at the universities is of little use in comparison with information as to the quality of their attainments.

Not a single scientific witness was called! Yet, if among the memoranda on particular topics invited from persons believed capable of furnishing valuable data or views, memoranda on the place of science in education and the kind of teaching required had been invited, there would not only have been no difficulty in securing such, but the documents would have had a high value. The mere fact that technical education was included in the enquiry, and indeed occupied a very considerable share of attention, is in itself sufficient evidence of the necessity of taking such a subject into consideration. But the Commission was clearly so constituted that it could not appreciate the importance of such action being taken, composed as it was very largely of men who cannot be regarded as belonging to the modern school of educational thought. Consequently, and most unfortunately, it has contributed little, if anything, towards the understanding of the difference between true scientific teaching—not merely of science, but of all subjects—and the sham article with which this country has so long been flooded; the wearying fight to bring this home to all concerned must therefore be continued with unremitting vigour. And this is the more disappointing, as it is so clear that, had the Commissioners advanced but very little further, they could have helped us in this direction also; for how otherwise are we to interpret the following admirable conclusion to the summary appended to the second section of the Report, that relating to the present condition of secondary education in England?—"In every phase of secondary teaching, the first aim should be to educate the mind, and not merely to convey information. It is a fundamental fault, which pervades many parts of the teaching now given in England, that the subject (literary, scientific, or technical) is too often taught in such a manner that it has little or no educational value. The largest of the problems which concern the future of secondary education is how to secure, as far as possible, that in all schools and in every branch of study the pupils shall be not only instructed, but educated. The degree in which this object may be attained will be largely influenced by the action of the authorities who prescribe the qualifications to be required in teachers, the conditions under which their work is to be done, and the means by which their work is to be tested."

Surely it was the duty of the Commissioners to take the first step towards solving what is admitted by themselves to be the largest of the problems concerning the future of secondary education—it is not likely that another Commission will be appointed to do this!

The Franco-German War first drew the attention of the world to the extraordinary value of exact training and scientific organisation. The lesson was most taken to heart by the Germans themselves, and by carefully training the *officers* of their army of industrial workers, they have since come off victorious in many important engagements with rival manufacturers and traders. An almost deeper lesson has recently been given to the world by the Japanese. Unless *we* are prepared to entirely disregard such lessons, we must introduce drastic reforms into our whole system of education. Scientific ways of working—scientific habits of thought, must be made national habits. The change would be nothing like so absolute as that made by the Japanese in their system of working, and if such a nation could entirely alter its front, it should not be beyond our power to do what is so clearly essential to our continued existence in comfort, let alone prosperity.[1]

[1] I cannot refrain from quoting the following conclusion to a striking article on the "Far Eastern Question" in to-day's *Times* (November 27). "Although nothing can excuse the short-sighted folly of our manufacturing classes in not providing for scientific research in the various branches of industry, yet it is the duty of a wise Government to take measures to counteract the folly of classes when it threatens the general interest. In one word, Great Britain stands at this moment in imminent danger of being beaten out of the most lucrative fields of commerce, simply because it does not recognise, while other nations do, the value of scientific organisation in the field, in the workshop, in the laboratory, and in the conduct of national policy." The *Daily Telegraph* has recently published an interesting series of letters—"Lessons in German"—conveying a similar lesson. We have waited long for the daily press to assist us: such evidence that the gravity of the situation is at last attracting attention is therefore most valuable.

To have conveyed this lesson to the nation should have been the first duty of the Commission. It is difficult to discover a sentence in the Report which indicates that they appreciate the gravity of the situation in which we are placed! Englishmen require but to be led properly at starting—when once they understand what to do, they will help themselves. The extraordinary outburst of educational activity which the country has witnessed during the past twenty years is proof that we are not behind in our estimation of the value of training; but the amateur fashion in which a very large proportion of our new enterprises have been conducted, shows only too clearly that an ideal is wanted to guide our labours: if we had this, co-ordination of means would naturally follow. We realise, in fact, that our army must be drilled, but we want a new national drill-book, in which the tactics to be adopted are *broadly* indicated. The Commissioners have only advised us as to the construction of barracks, and the choice of a staff; still, if we follow their advice and not only choose our staff, the Minister and his Educational Council, wisely, but impose on the latter in the first instance the task of most carefully framing the outlines of a system of tactics, all may yet be well.

Whatever may be the shortcomings of the Report in these respects, all who study it must agree that it is a work of the very highest value, drawn up with great skill, and that the recommendations embodied in it merit the most serious consideration.

In addition to the Report, there are three volumes of minutes of the evidence tendered by eighty-five witnesses; a fifth volume contains memoranda and answers to Commissioners' questions; two others are devoted to the reports of Assistant Commissioners; and the remaining two contain a summary, an index and statistical tables.

As the Commissioners point out, a mastery of the details is essential to a comprehension of the problems they had to solve, and an appraisement of the solutions they offer. Perhaps those who can read between the lines may be inclined to draw inferences in some cases different from those arrived at by the Commission; and it is clear, also, that the evidence is not all equally trustworthy—at least one of the Assistant Commissioners' reports having called forth what appear to be just protests.

The opening section of the Report contains a very brief, but most instructive, historical sketch of the gradual development since 1867 of the various agencies which have induced progress; four are chiefly referred to: the Elementary Education Act of 1870, the Science and Art Department, the various new University Colleges and the women's colleges, and the Technical Instruction Act; the work accomplished by voluntary effort, and the great increase in public interest in educational matters being also specially mentioned. Most hopeful in tone, this section is sadly wanting in scale; while no distinction is made between the work done under the Science and Art Department and by the University Colleges, the reference to University Extension is of the roseate order usually made by its extreme advocates. It is unfortunate that no attempt to estimate the relative values of the different elements of our educational "system" is included in this or the following section.

The second section deals with the present condition of secondary education in England, under the three heads: authorities exercising control, the existing supply of secondary teaching, and bodies which examine or inspect. The problems which the survey suggests are then considered, and, among others, the defects are pointed out in the present system of science and art grants, in the supply of schools, and in the provision of scholarships; but, unfortunately, under this last heading no attempt is made to take fully into account the bad, as well as the good, effect on scholars and schools of scholarships: the subversive effect they have produced at our universities is so generally recognised by competent observers that this subject should have been carefully considered. In discussing the internal organisation of schools in this section, stress is laid on the need of training for secondary teachers. This, perhaps more than any other portion of the Report, requires most careful study in connection with the evidence, and remarks on it must be reserved for a future occasion. The measures to be taken in the training of teachers will undoubtedly be the most vital point in any future legislative action arising out of this Report; for given good teachers, good work will necessarily be done, whatever the conditions may be in other respects.

A most important paragraph occurs in the summary to this section, which will need to be very carefully discussed, viz. that "In organising the supply of schools, it will be of the utmost importance to provide adequately for the literary type of secondary education, no less than for the scientific and the technical." One question to be considered is whether there should not be a *mean* type instead of distinct types throughout all the earlier stages, at least, of secondary education. Unfortunately this issue seems never to have been presented to the Commission.

The third section, which is by far the longest, is devoted to a review of the evidence, and a discussion of the suggestions made by certain witnesses.

The fourth, and practically the most important, contains the recommendations which are unanimously brought forward by the Commissioners. The primary recommendation, to which probably most interest attaches, is that of a *Central Authority* calculated to bring the State into a fitting relation to secondary education—words deserving of special notice. The proposal made is essentially English in spirit, and thoroughly calculated to fall in with our belief in a decentralised system of local self-government giving the maximum opportunity to individuals. "So far from desiring that secondary education should be a matter for a department of State to control," say the Commissioners, "we propose to leave the initiative in public action to local authorities, and to prevent even those authorities from superseding the action of individuals. So far from attempting to induce uniformity, we trust that a free and spontaneous variety, and an open field for experiment and enterprise of all kinds, will be scrupulously observed. We conceive, in short, that some central authority is required, not in order to control, but rather to supervise the secondary education of the country, not to override or supersede local action, but to endeavour to bring about among the various agencies which provide that education a harmony and co-operation which are now wanting."

The Central Authority proposed is a Minister responsible to Parliament presiding over a department formed by merging into one body the present Education Department, the Science and Art Department, and the Charity Commissioners. Apart from other advantages, the appointment of a Minister of Education must have the effect of impressing on public attention the immense national importance of educational affairs; and much as we have been indebted in the past to the several departments which it is suggested should now be fused into one, their methods are too inelastic to suit modern needs, and the proposed change is probably one which will meet with the approval of all true friends of education.

It is further proposed to associate with the central authority an Educational Council, not exceeding twelve members, of whom one-third might be appointed by the Crown; one-third by the four universities of Oxford, Cambridge, London, and Victoria; whilst the remaining one-third might be co-opted from among experienced members of the teaching profession. This proposal will probably be viewed in very different ways, but it appears to be one which is eminently calculated to pre-

serve the educational freshness of the central authority, and limit within reasonable bounds the display by it of those peculiarities which are too frequently manifest in all official bodies; through such a body, the interest of the Minister, and through him of the country at large, in current educational problems would be awakened and maintained, and he would become fully open to influence from without; at the same time, it should minimise the tendency to subordinate educational to political interests. But to secure these ends, the Council must contain a large professional element, and its members must not in any case be mere men of affairs, but fully acquainted with educational requirements.

It is impossible now to discuss the remaining recommendations.

At the outset, the Commissioners state that they have felt very strongly the need of dispatch, in order that the country may without delay derive advantage from legislation framed on proper lines. It is to be supposed that the late Government would have acted promptly in the matter, and it is to be hoped that its successors will be at once ready to appreciate the vast importance to our nation of well-considered legislation in the direction of the scheme put forward by the Commissioners. It would probably be difficult to prepare one in which due provision is more fully made to conserve what is good in our present system, while permitting the fullest play to the agencies which determine progress.

To conclude, in the eloquent final words of the Report, "it is not merely in the interest of the material prosperity and intellectual activity of the nation, but no less in that of its happiness and its moral strength, that the extension and reorganisation of secondary education seem entitled to a place among the first subjects with which social legislation ought to deal."

HENRY E. ARMSTRONG.

PAGAN IRELAND.[1]

TO Colonel Wood-Martin is due the credit of the first attempt to co-ordinate the vast stores of archæological lore which lie buried in the publications of the various Irish societies. The subject is a really fine one, and it was time that the data of Irish archæology should be collated and presented in a convenient form. This the author has accomplished. There are two ways of regarding a book: the one is to expect the author to write the book in the way you (whoever "you" may happen to be) would like to have it written, and the other is the acceptance of the author's position, and to deal with the work from that point of view. It is not difficult to discover the ideals which the author has in this instance placed before himself. "In order to arrive at the truth, it is desirable to test the opinions and conclusions of those who, by a careful analysis of the probabilities and facts recorded by them, have travelled over the same ground before. . . . Antiquarian research in Ireland may, with advantage, be directed towards filling in the social history of primitive man; articles which are the result of the handiwork of the aborigines illustrate, with much exactitude, life in the olden days. . . . If material objects be accepted as proofs of the pagan ideas and customs of the aborigines, surely the evidence of still existent superstitious observances of the peasantry, which can be traced to a pre-Christian source, ought to be received with, at least, the same authority. . . . It is to be hoped that research into the past, on these lines, may contribute to the reconstruction of early history." This is a sound method of treating archæology; our author clearly recognises that the value of archæology, whether it be of objects made by man, or of folk-lore, lies in the use to which it can be put in deciphering the early history of man, and he admits that in Ireland "we have made but little progress in higher scientific archæology; and the ancient antiquities of Ireland still remain in an unclassified condition." This is a refreshing admission, and the justification of this statement is only too apparent to those who know the present unintelligent arrangement of the magnificent collections of the Royal Irish Academy, now housed in the Dublin Science and Art Museum. The splendid opportunities for archæological research which exist in Ireland, are woefully neglected, and it is to be hoped that Colonel Wood-Martin's book will serve to stimulate an interest in this fascinating and promising field of inquiry. We are glad to note that he refers to the "vandalism" of the Board of Works with regard to ancient monuments; but a great deal more has yet to be said on this subject.

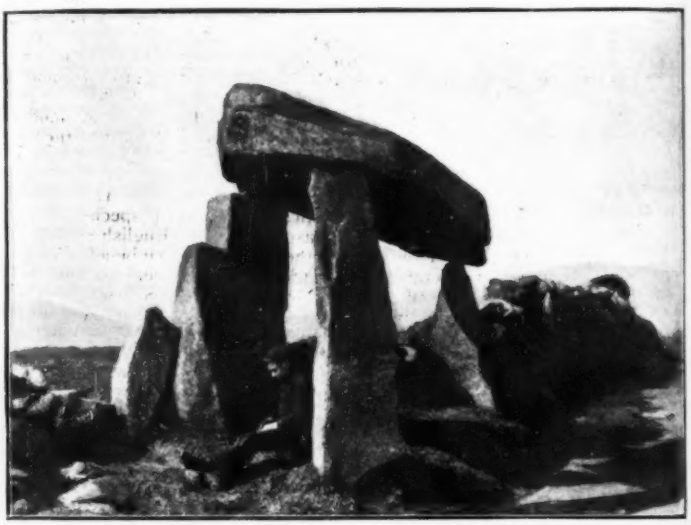

FIG. 1.—Legananny Cromleac, Castlewellan, Co. Down, 10 feet in height. (From Welch's Irish views.)

In his chapters on "Early History," "The Disposal of the Dead—Were the Aborigines Cannibals?" and "Traces of the Elder Faiths," the author deals with customs and beliefs as recorded in ancient accounts, or as witnessed for by actual remains, or as perpetuated in an attenuated form in folk-custom. The facts here collected together are most interesting, and throw considerable light on the early social condition of Ireland, a good deal of which will be new to the ordinary reader.

The author is very weak in his account of the ethnology of ancient Ireland; but this is a matter in which the author, not being a professed anthropologist, is not so much to blame, and there is yet much investigation to be done before we can speak with certitude. At

[1] "Pagan Ireland, an Archæological Sketch. A Handbook of Irish Pre-Christian Antiquities." By W. G. Wood-Martin, M.R.I.A., author of "The Lake Dwellings of Ireland," "The Rude Stone Monuments of Ireland," &c. 689 pp., 410 figs., and map. (London: Longmans, Green, and Co., 1895.)

all events it is a pity to promulgate the statement that "the Esquimaux and cognate people appear to be all members of the most primitive family amongst the nations," and he adopts the view that the men of the period of the megaceros and the reindeer "approximated in type to that now inhabiting the Arctic regions." He is apparently unaware of the distinguishing cranial characters of the Lapps and Eskimo. While admitting that there is a culture analogy between the latter people and those of Neolithic times in the British Islands, there is no evidence for ascribing them to the same race. The figures of the skulls on p. 21 are ludicrously erroneous.

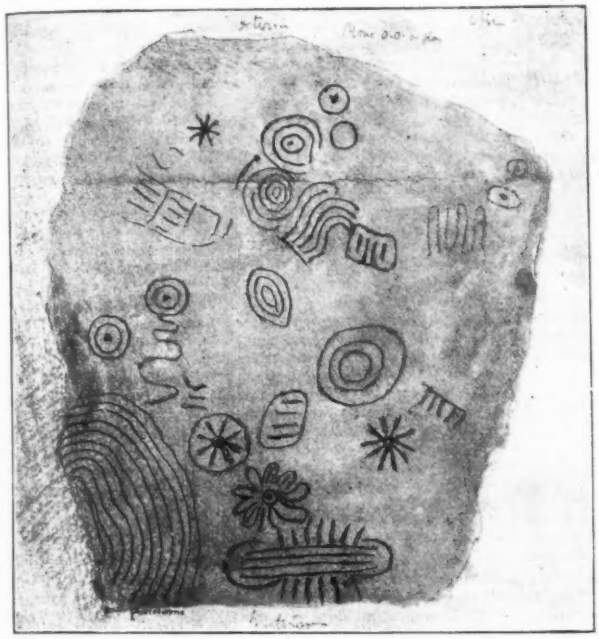

FIG. 2.—Inscribed Stone from a Carn on the Loughcrew Hills, Co. Meath.

When Colonel Wood-Martin passes to the more well-beaten paths of archæology, there is less to criticise, and it is evident that he writes not only of facts gathered from a large range of reading, but also from wide personal knowledge. We have a satisfactory epitome of what is known on early domestic architecture in the shape of beehive huts, souterrains, cashels or forts, raths, and the like; as the author has made a special study of crannogs, the Irish lake-dwellings are adequately described. There is an interesting chapter containing a good deal of folklore on various rude stone monuments, including cromleacs, carns or tumuli, pillar-stones, holed-stones, &c. Clay vessels and stone urns have a chapter to themselves, and a number of them are figured. In dealing with stone implements we find this statement: "In the Palæolithic or ancient stone period, the manufacture of implements was so rude that it is difficult to distinguish between the flints artificially chipped by human agency, and those shaped by natural causes." As it stands this is very misleading, for the ordinary Palæolithic implement is as recognisable as the Neolithic.

A succinct account is given of the various kinds of stone arrow-heads, and of the bronze swords, daggers and spear-heads, and they are classified according to their several types; but we are not given any information as to their distribution, nor is any clue given as to their relative dates of the bronze weapons or of their foreign equivalents. The well-known story of the evolution of the socketed hatchet from the simple flat copper celt is, however, detailed. The famous gold ornaments are duly described, and from the number of ornaments in museums, especially in the Museum of the Royal Irish Academy, and from the records of finds, there is abundant evidence that Ireland was at one time very rich in that precious metal; indeed, it is probable that gold ornaments were an important article of trade, and we know that the Danes and other Scandinavians raided the country and rifled the tumuli and other tombs, being tempted by these valuables. During the present century, between £30,000 and £40,000 worth of gold ornaments are known to have been melted down.

A number of the mysterious rock-scribings are illustrated, but no fresh light is thrown upon them; indeed, the chapter on ornamentation is not so satisfactory as it might have been.

The book is well printed, copiously illustrated, carefully indexed, and one very valuable feature is the bibliography, which gives a classified list of over a thousand references.

To sum up: the author has aimed high, and has evidently spared no pains to do his best, and he has succeeded in producing a book which affords an extremely convenient introduction to Irish archæology; he has compiled diligently, but the exercise of more criticism, and of a broader way of regarding the data of archæology, would have resulted in a better book; despite his own ideals the author has not succeeded in getting, so to speak, outside his subject.

FIG. 3.—Group of miscellaneous Gold Ornaments (total value, £1000). Slightly less than one-half natural size.

THE METRIC SYSTEM OF WEIGHTS AND MEASURES.

A DEPUTATION representing forty-six Chambers of Commerce, announced in these columns a fortnight ago, waited upon Mr. Balfour, First Lord of the Treasury, on November 20, to urge upon the Government the desirability of adopting the metric system of weights and measures, as recommended by the late Select Committee on the subject. It will be gratifying to men of science to know that the commercial world has been brought to support a reform advocated by them for many years. When the question was merely one of simplicity, little importance was attached to it, but now that commercial men have learned that our chaotic system of weights and measures is a serious obstacle to international trade, the matter is taken into the region of practical politics. On the whole, Mr. Balfour's reply to the deputation is satisfactory. The best way to the adoption of the metric system in this country is by educating the mass of the people in its use; in other words, the transition will have to be gradual rather than an abrupt change brought about by legal process. By all means let the metric system be legalised, but it cannot be seriously believed that in two years people would submit to having the system thrust upon them by Act of Parliament. The Select Committee of the House of Commons recommended "That the metrical system of weights and measures be taught in all public elementary schools as a necessary and integral part of arithmetic, and that decimals be introduced at an earlier period of the school curriculum than it is at present." This recommendation ought certainly to be carried out, for when the use of decimals has become common, and the convenience of the metric units has become widely known, there will be little need for legislation to make the use of the system compulsory. But the question is not only one of ways and means; for if England adopts the metric system, then France will, in all probability, adopt Greenwich time, and there will then be one time system throughout the world.

The deputation to Mr. Balfour was introduced by Sir A. K. Rollit, M.P., who was supported in his remarks by Sir Henry Roscoe, Sir Samuel Montague, M.P., Mr. Arnold-Forster, M.P., and several other members.

Sir Henry Roscoe said: As Chairman of the Select Committee, the report of which has been referred to in the memorial, I desire, Mr. Balfour, to be allowed to say a few words on the question at issue, of which, I may add, it is difficult to overestimate the importance; and, in the first place, I wish to remark that the Committee consisted of seventeen Members of Parliament, chosen from both sides of the House, and that of these seventeen only one was opposed to the recommendations made by the majority and embodied in the report—*i.e.* that the metrical system of weights and measures should be at once rendered legal for all purposes of trade as well as for manufacture; and that, further, within a space of two years, the metrical be adopted as the only legalised system. These recommendations were founded on the evidence given by thirty-two witnesses, representing very many different interests, and selected from persons of every class of the community. Of these only one—*i.e.* Sir Frederick Bramwell—was in favour of retaining the present system, although he had no objection to the legalisation of the metrical weights and measures. With this single exception all the witnesses expressed a very strong opinion as to the evil effects arising from the complicated and unsatisfactory condition of our present system of weights and measures. They called attention to the distinct and serious degree to which, in their opinion, our commerce—especially our foreign commerce—is handicapped in consequence of the use of the present system, differing, as it does, from that now adopted by every European nation except ourselves and Russia, as well as by far the greater majority of the non-European countries with which this kingdom trades. Not only, however, was it proved to the satisfaction of the Committee that our foreign trade suffers greatly, but also that our home trade would be benefited by the adoption of a simpler and uniform system of weights and measures.

From the educational side, also, evidence showed the urgent need of an adoption of a simpler system, and it appears from the statements of experts that the school time now devoted to arithmetic would be lessened by one year if a simpler system were substituted for the cumbrous one now in vogue, and thus our children placed on a par with those taught in foreign schools. This led to the second recommendation—viz. "That the metrical system be taught in all public elementary schools as a necessary and integral part of arithmetic, and that decimals be introduced at an earlier period of the school curriculum than is the case at present, and before vulgar fractions."

On inquiry, the Committee learnt that the compulsory changes from old and complicated to a new and simple system had been accomplished in Germany, in Norway and Sweden, in Switzerland, in Italy, in Bulgaria, in Japan, in Turkey, and even amongst the black population of French dependencies in Africa, without any difficulty in a comparatively short period of time, and without any opposition; that in every case the people in these countries are satisfied that the change has been for the better, and that in no single instance has an attempt been made to recur to the old system.

It has often been stated that this agitation for the adoption of the metrical system is got up by scientific men or faddists, who have no knowledge of the practical difficulties which will arise in the application of a new system to ordinary life. That this is not so is shown not only by the composition of the present deputation representing, as it does, so powerfully the commercial interests of the Empire, but also by the statement emphasised in the evidence given before the Committee, that the working classes, at any rate the more intelligent of them, are interesting themselves in the matter and have passed very strong resolutions in favour of the change. Thus the Trade Union Congress held in Glasgow in September 1892, at which 495 delegates were present, representing nearly a million and a quarter of members, passed the following resolution: "That in the opinion of this congress it is highly desirable in the interests of the working classes and of the general trade of the country that the decimal system (meaning the metrical system) of weights and measures shall be adopted in Great Britain and Ireland as a national system, and that a Parliamentary Committee be instructed to promote legislation on the question"; whilst a similar resolution was passed at the Belfast Congress in the following year, at which 380 delegates were present representing 900,000 members. A large number of other trade societies have sent in memorials in favour of the adoption of the metrical system; amongst many others, the United Bargemen and Watermen's Protection Society, the Working Men's Club and Institute Union, the Trades Councils of Sheffield, Glasgow and Bolton, the National Union of Gas-workers, the Boot and Shoe Union of Leicester, the Manchester and Salford Trades Council, the Dockers Union, the Amalgamated Society of Railway Servants in Scotland, and the General Railway Workers Union.

Important evidence was obtained from manufacturers who have adopted the metrical system in their works; the most interesting of these is perhaps that of Captain Sankey, a director of the well-known firm of Willans and Robinson, engineers. This firm has adopted the metrical measurements, not only to their own advantage, but to the satisfaction and with the cordial co-operation of their workmen, some of whom are merely ordinary English labourers. A series of questions was drawn up by the firm, for the purpose of ascertaining how far the men were satisfied or otherwise with the change, and the answers to a number of searching questions showed that the men were not only satisfied but pleased, and had no wish to recur to the old measurements. An honourable member of the Committee asked this witness whether he had found that his men had any difficulty in adapting themselves almost immediately to the new system, and the answer was, "Not after the first few days." The witness added: "I asked that very question to the head of our tool-room, and he said it was a little awkward for a time. I said, 'About how long?' and he said 'Two days.'" And in further examination this witness stated that the workmen knew nothing of the metrical system beforehand.

Another interesting witness was the Chairman of the Incorporated Society of Inspectors of Weights and Measures. He came forward as an expert in these matters, and he agreed that the metrical system ought to be made compulsory, and in expressing this opinion he spoke for his Society. He gave a long list of anomalous customary measures, which are now, although illegal, still in use

in various parts of the country. He explained that it was difficult, under the present system, to prevent the use of these irregular weights, but that if a new unit or system were adopted, then it would be possible to put an end to the employment of these ridiculous so-called customary weights.

The Committee found it impossible to obtain any evidence either from manufacturers, from retail dealers, or, with the exception I have mentioned, from professional men, in opposition to the recommendations which they have made; and amongst the members of the Committee the one opponent of their recommendations was Mr. Stevenson, who added a report of his own, which is printed with the evidence, but which did not find a seconder. Reference was made to the fact that, in the Parliamentary Report of a Committee which sat thirty-three years ago on this subject, two very distinguished men of science—*i.e.* the late Astronomer Royal, Sir George Airy, and Sir John Herschel—expressed strong opinions in opposition to the adoption of the metrical system. One witness, Lord Kelvin, on being asked by the Chairman how far in his opinion that evidence applies at the present time, answered: "I believe these two great men would see things very differently now; their minds had not been opened to the great advantages of the metrical system. Since they gave that evidence every country in Europe has accepted the metrical system except ourselves, and the general understanding of these subjects has certainly advanced very much"; and he went on to say that he did not think that at the present moment a Committee on the subject need consider the objections thus raised thirty years ago as being of importance; on the contrary, he would like to see the metrical system made compulsory after the lapse of a certain period, and would not be satisfied without a thorough adoption of this as the only legal system in the country. Moreover, he did not think decimalisation of the coinage was at all a necessary accompaniment for the adoption of the metrical system of weights and measures.

Further evidence went to show that in the United States the metrical system was actually legal, was in use within the State of Utah, and has been adopted as a compulsory system for all pharmaceutical and medical purposes; that this latter also is the case in Russia; and quite recently the announcement has been made that in the new edition of the "British Pharmacopœia," about to be issued, the metrical weights and measures will be adopted. It appeared to be a general opinion amongst witnesses consulted by the Committee that it only requires that England should take the initiative, in order that both Russia and the United States—the only civilised countries now not using the system—should at once adopt it, and thus all nations would have one and the same system, and that this would be an incalculable benefit to mankind.

Mr. Balfour is reported by the *Times* to have replied as follows: "I have listened with very great interest to the powerful speeches that have been made upon the important subject with regard to which we are met here to-day. If I may express my own opinion upon the merits of the case, there can be no doubt I think whatever that the judgment of the whole civilised world, not excluding the countries which still adhere to the antiquated systems under which we suffer, has long decided that the metric system is the only rational system. Scientific men in this country have long been driven to use it in their writings, to use it in their calculations, and, if I may so express it, to think in it, to think out the problems in which they deal in the system which we owe to the ingenuity of the French. What men of science have long been obliged to do—not merely because the international character of science makes it desirable, but also because the calculations are so much more rapid, so much more convenient—what men of science for those reasons are obliged to do, I believe that commercial firms in all parts of the country are beginning to think they must do also. On that point I do not think that argument is possible. The solitary argument which appears to have been alleged on the other side is that the existing English system is a good gymnastic for the mind. I dare say it would be a very good gymnastic for the body if, instead of having macadamised roads, we were obliged to make our way over pathless heaths and plunge through ditches and over hedges; but though it would be an excellent gymnastic for the body it would not be a convenient method of getting from place to place, and I do not think any one is likely to recommend that we should return to the primitive kinds of locomotion once used by our forefathers. There appears, therefore, to be an absolute agreement on the merits of the case. There is no such agreement with regard to the practicability or the ease of carrying out any great change. We in this country are rather in the condition of an industrial concern which was using antiquated plant, but which felt that it could not renew that plant according to modern requirements without an immense expenditure of capital which for some years would destroy all the profits, or a large part of the profits, of the undertaking. In precisely the same way, while everybody admits that the change when once effected would be a change of almost universal beneficence, I think we ought not to conceal from ourselves that there would be loss and inconvenience during the period of transition. I think we have only got to consider our own personal experience to see that that is so. Like the rest of the world, I have had to read books in which the metric system was the one in use. As I have been brought up on the English system, there has always been a certain difficulty in representing to the imagination without effort and immediately by an automatic process exactly what was intended. To translate miles into kilometres is not a very difficult process, but it is not automatic even to the person who knows the exact length of the kilometre and mile. And what is difficult to us who have been to a certain extent habituated to both systems, would certainly be difficult to the great mass of retail traders and the great body of the poor. They have been accustomed to think in one kind of measure, and to require them by law suddenly to think in another kind is to compel them to go through an effort which I think every one will admit would be an arduous effort in some cases, and an effort which would not be unaccompanied by mistakes and difficulties on the part of those who are unaccustomed to it. It is a matter, it will be observed, largely of familiarity and imagination. We all know what we mean by a yard. To translate that into a metre requires a little effort. We all know what we mean by a mile, to represent it in the imagination, but to translate it into a kilometre requires an effort, and I do not think we should underrate the obstacles in carrying out the beneficent change. I was struck by what fell from Sir Henry Roscoe and some other members of the deputation with regard to the extraordinary vitality in England of antiquated and illegal weights and measures in different parts of the country. Although our existing measures are the only legal ones, it appears that other measures are in habitual use by large portions of the population. If old measures are so difficult to kill, as they clearly are, we must not forget that we have a very heavy task before us to bring about the great change of the existing system to the decimal system. I have been informed that in France, where the metric system has now long been in use, where it is universally believed in as the only rational system, I believe that even in France, in some parts, the population prefer some of the old measures which their fathers were accustomed to rather than the rational system which has now for more than two generations been the only legal one in force. Therefore we ought not to approach the solution of this problem in too sanguine a spirit. I observe that there are three recommendations which the Chambers of Commerce have formulated and embodied in the memorial presented to me to-day. The first is that the metrical system of weights and measures should at once be legalised for all purposes. The second is that it should be the only legal system allowed in this country after two years. The third is that every effort should be made to teach it in the elementary schools. With the first and third of these I find myself in entire agreement. I am told that there are legal obstacles to the use in all trades, and I am quite unable to see why that obstacle should be continued. I think it is our business to do everything we can to smooth the transition from the old to the new system, and certainly the first step towards smoothing that transition would be to make legal that which we think desirable and which we may ultimately think necessary. I was struck by an observation from Mr. Arnold-Forster in regard to the standing orders of the House of Commons, and to the exclusion of the metric system from our national manufactures—that is, manufactures undertaken by the Government. I think both of those are topics well worthy of consideration, and I shall consult with my friend Mr. Ritchie and the other departments of the Government concerned to see whether from either of those points of view anything can be done to meet the general wishes of the commercial classes as represented by the Chambers of Commerce. With regard to the teaching of the metric system in elementary schools, I believe something has been done already in that direction by the Education Department, but on that topic also I shall consult

Sir John Gorst and see whether we cannot do something to spur on the teaching of the metric system in the schools, and thereby familiarising the imagination of the rising generation to a system which perhaps ultimately will be the only one they will be permitted to use. With regard, however, to the second proposition in the order of statement by the Chambers of Commerce, you will have gathered from what I have said that I should see very great difficulties in compelling every class in the community suddenly to alter its familiar and habitual practice in regard to the weights and measures in which it deals. If I may venture to say so, I hardly think that the Chambers of Commerce, or even the trade union congresses, are adequate representatives of the kind of feeling which would probably animate the great mass of small retail dealers and those who buy their goods from such dealers, who would suddenly find all their familiar landmarks swept away and unfamiliar things put in their places. You represent the great commercial interests of the country, and possibly you might find a degree of opposition to your proposals which you little anticipated if you were to endeavour to drive into every cranny of our social system changes which no doubt would be very beneficial as applied to the great industries and manufactures. That leads me to ask—if the advantages of the metric system as compared with the existing system be so great as you tell me they are, as I fully believe they are—whether they could not now be adopted, for instance, in shipbuilding yards on the Clyde, in the great machine-making industries of Manchester, and in such commercial centres as Belfast. I think one gentleman did mention a firm which had employed it, and which had no difficulty in employing it. The engineers do it now, and they have not found much difficulty in doing it, and they have derived much benefit from it. Surely it is within the province of private enterprise to extend that system to every one of the great industries which bring us into relation with foreign countries. The foreign meat trade is already largely carried on on a decimal system, but not the metric. What I want to insist upon is that, while it is of great importance to render such a change easy, it is within the province of private enterprise to carry it out gradually in those great industries. I cannot but believe that if you represent, as I am sure you do, the feeling of the great industries in this matter, we shall find, without any compulsion on the part of the Government at all, the metric system making its way through all the leading industries. It must be legalised certainly, but, when legalised, it will make its way. It is evident that, in so far as that process is carried on, you would enormously facilitate that ultimate compulsory change to which we all look forward, but which, I think, could not, with safety or advantage, be undertaken by the Government till public opinion is more prepared for it than at present. The public opinion with which we have got to deal, and which we are bound to consider, is not the public opinion of the great manufacturers alone, but the public opinion of every man and woman you meet in the street. While I look forward to the time, and no distant time, when they will adopt the change without difficulty and without repugnance, I should like to see private enterprise do more than it has done up to the present to show that the change can be adopted without inconvenience, and that it carries with it all the benefits which I, in common with you, firmly believe to be attached to the metric system, and which it is impossible to associate with the arbitrary, perverse, and utterly irrational system under which we have all had the misfortune to grow up."

NOTES.

A LARGE and influential deputation is to wait on the Duke of Devonshire at noon to-day to urge on the Government the importance of introducing, at an early date, a Bill appointing a Statutory Commission to give effect to the recommendations of the late Royal Commission on the London University question.

THE first meeting of the General Committee of the Huxley Memorial was held, under the presidency of the Duke of Devonshire, yesterday, as we went to press. The chief object of the meeting was to decide the form which the memorial should take. The long list of the General Committee, consisting of the names of men of light and leading in all parts of the world, is a striking testimony to Huxley's greatness.

THE Egyptian Government have determined to commence a geological survey of the "land of Egypt." The work will be begun next year, and will take about three years for its completion, the estimated cost being £25,000. To carry out the proposed plans, a wise selection of a geologist has been made in the person of Captain H. G. Lyons, R.E., who is at present engaged (under the Public Works Department of the Egyptian Government) in superintending the excavation of the ruined temples of Philæ. Captain Lyons has already written an excellent article on the "Stratigraphy and Physiography of the Libyan Desert of Egypt" in the Geological Society's *Journal* for 1894, and has also made extensive explorations on the Upper Nile. Had the Egyptian Government taken this step some years ago, they might have saved some considerable sums of money which they have squandered in searches for petroleum and various minerals, undertaken at the instigation of inexperienced and interested advisers.

A SHARP earthquake shock occurred at Athens at 7.30 on Wednesday morning, and was also felt at Chalcis, Livadia, Thebes, and Corinth.

DR. J. D. GILCHRIST has been appointed Marine Biologist to the Government of the Cape of Good Hope. He will be charged with the investigation of the marine resources of the country, especially in their practical relations to the fisheries.

A COMMITTEE has been formed to make arrangements for presenting to Prof. Adolf Bastian, Professor of Ethnology in Berlin, a volume of original essays on various branches of ethnology, anthropology, and kindred sciences, when he attains his seventieth birthday in June next.

WE learn from the *Lancet*, that the Health Committee of the Glasgow Town Council has decided to establish and equip a complete bacteriological department in the sanitary buildings now in course of erection. The laboratory is to be in charge of an expert in bacteriology.

THE *British Medical Journal* states that Prof. Loeffler, of Greifswald, the discoverer of the diphtheria bacillus, has received from the French Government the Officer's Cross of the Legion of Honour.

DR. CARTWRIGHT WOOD has been granted £100 out of the Goldsmiths' Company's grant allocated by the Committee of the Conjoint Laboratories of the Royal Colleges of Physicians and Surgeons, for investigations as to improved means of treating horses with a view to obtaining diphtheria antitoxic serum in a shorter time than is possible by the methods hitherto in use.

OUR contemporary *Invention* has lately been brought out in a popular penny series. We hope and believe that in this form it will play a useful part by showing to a wide circle of readers some of the work that has been, and is being, done in the world of science, and by indicating how intimately scientific research is connected with industrial progress.

WE notice with regret the death of Mr. J. Traill Taylor, editor of the *British Journal of Photography*. He was in his sixty-ninth year, and was widely known and respected in photographic circles. We have also to record the death of Prof. George Lawson, Professor of Chemistry and Mineralogy in the University of Halifax, Nova Scotia, and formerly President of the Royal Society of Canada.

THE death is announced of Surgeon-Major George Edward Dobson, F.R.S., at the age of forty-seven. He was awarded the gold medal of the Dublin Pathological Society in 1867 for his essay on the diagnosis and pathology of the injuries and diseases of the shoulder-joint. He also wrote "Medical Hints to Travellers," published by the Royal Geographical Society;

"Monograph of the Asiatic Chiroptera," 1876; "Catalogue of the Chiroptera in the British Museum," 1878, a complete natural history of the order; and "Monograph of the Insectivora, Systematic and Anatomical," in which the zoology and anatomical structure of the species were concurrently investigated; and he was the author of numerous other articles, published in the *Proceedings* of various scientific societies and in scientific journals. He was elected into the Royal Society in 1883, and was a corresponding member of the Academy of Natural Sciences of Philadelphia and of the Biological Society of Washington.

A GREAT Frenchman has just passed away in the person of M. Barthélemy Saint-Hilaire. He was born so far back as August 19, 1805, and the fiftieth anniversary of his election into the Academy of Moral and Political Sciences was celebrated in 1889 at the Institute of France. Like many other men in France, he was both philosopher and statesman. He translated the complete works of Aristotle, and was the author of numerous original works. He spent some time in a journey to Egypt with M. Ferdinand de Lesseps, to explore the Isthmus of Suez; and he shared to the full the firm belief of the creator of the Suez Canal in the feasibility of the undertaking. After his return from Egypt he published his "Letters on Egypt," 1856, and "Egypt and the Great Suez Canal," 1857. In 1860 M. Saint-Hilaire published his work on "Buddha and his Religion"; in 1865 appeared his "Mahomet and the Koran," preceded by an introduction on the Mutual Duties of Philosophy and Religion, and in 1866 his "Philosophy of the Two Ampères." He was Secretary-General of the Presidency of the French Republic, after the war of 1871. Upon the fall of M. Thiers, he resumed his great translation of Aristotle. In 1880, at the age of seventy-five, he became Minister for Foreign Affairs in the Jules Ferry Cabinet, from which he retired on the accession to power of Gambetta in 1881.

A COMPLETE change in the type of weather took place over the British Islands during the latter part of last week. The *Daily Weather Report* of the 23rd inst. showed that an area of high barometric pressure was spreading over our western coasts from the Atlantic, while an area of low barometric pressure, which had formed over the North Sea, was crossing the Netherlands. During the following days this disturbance passed to the south of Italy, and, in connection with very high barometer readings in Scandinavia, its passage caused strong north-easterly and easterly gales in the south and east of England, and very high seas in the English Channel, while on the continent it was accompanied by much snow and sleet. Although the force of the wind was not so strong inland, the pressure recorded at Greenwich Observatory on Sunday was 16 lb. on the square foot, which by the revised factor for the conversion of wind pressure to velocity is equivalent to a rate of about 76 miles in the hour.

THE terms of the competition for the Thousand Guinea Prize offered by the *Engineer* for mechanical road carriages are published in the current number of our contemporary. The limit of weight has been fixed at two tons, and the speed at ten miles an hour; while in the case of oil being used as the motive power, the flashing point is fixed at 73° F. The competition, it is thought, cannot take place before October 1896, when the various vehicles—two classes of two tons each, and two of one ton each—will be required to run 200 miles, and Sir F. Bramwell, Mr. J. A. F. Aspinall, and Dr. John Hopkinson will act as judges.

THE convention between Italy and Switzerland for the construction of the Simplon Tunnel was signed at Berne on Monday. The programme of the works to be followed is that already approved by the Jura-Simplon Company, the Swiss Federal Council, and the Italian Government. When the tunnel is completed, the nearest seaport for French Switzerland, Haute Savoie, and the Valais will no longer be Marseilles, but Genoa, and the shortest route from Milan, Piacenza, Venice, Genoa, and Trieste to Paris will be through the tunnel.

WE learn through the *Times* that the United States Nicaragua Canal Commission, appointed by President Cleveland last spring, has reported that it is neither advisable nor practicable to attempt the construction of a canal upon the data at present available. New surveys are needed before any final judgment can be formed, but the provisional estimate of the cost by this Commission is about £27,000,000, nearly double the Maritime Canal Company's conditional estimate. That Company's report is very strongly criticised in detail and in general, to the effect that it is not based on a thorough knowledge of the physics of the site. Their proposed dam in Ochoa is regarded as unsafe, dangerous, and subject to floods, the proposed entrance to Greytown Harbour is deemed wrongly placed, and the canal itself is considered inadequate in width and depth. The numerous technical criticisms of this report all point in the same direction—namely, that no such canal as that contemplated by the Maritime Company can be built in the way which they design, or for the money which they would expend upon it.

THE opening meeting of the Conference convened by the Board of Trade on the subject of the revised regulations proposed to be made under the Electric Lighting Acts, 1882 and 1888, was noted in our last issue (p. 60). We extract from the *Times*' report of the second day's proceedings the more important decisions arrived at. The Chairman, Sir Courtenay Boyle, stated that he had carefully considered the very important representation made the previous day on the subject of the definition of low pressure, and he thought it would be for the convenience of those interested if a decision were reserved for a short time, so that the Board of Trade might appoint a small committee, not exceeding three, of expert advisers, carefully to consider the scientific aspect of the question, and to make a suggestion to the Department. This was approved by the meeting. The discussion of Clause 35 of the revised regulations relating to street boxes, pointed to the need for a definition of street boxes, and led the Chairman to suggest that the clause should apply only to street boxes containing transformers. It was agreed that the clause should read thus: "In the construction of street boxes used as transformer chambers reasonable means shall be adopted to prevent as far as possible any influx or accumulation of gas or water either from the adjacent soil or by means of pipes; and ample provision shall be made by ventilation or otherwise for the immediate escape of any gas which may by accident have obtained access to the box, and for the prevention of danger from sparking." The Chairman promised to consider whether the Board of Trade could make a regulation for the ventilation of street boxes of a certain dimension. Opposition was offered to Clause 37, which provided that "the casing of any high-pressure electric lines shall be continued within street boxes," and the Chairman said the clause would be struck out on the understanding that it might be necessary to continue the old regulation, so as to prevent danger arising by high-pressure lines passing through transformer chambers not being properly cased. Objections having been raised to Clause 38, relating to converting stations, the Chairman said he thought the old regulation would better meet the case. That regulation was as follows: "Converting stations, or points in a system of distribution to which a high-pressure supply is given from generating stations, and from which a low-pressure supply is given to one or more consumers, and which are not on the consumer's premises, shall be established in suitable places, which are in the sole

occupation and charge of the undertakers." After discussion the Chairman accepted Clause 41 in the following form: "A suitable safety fuse or other automatic disconnector shall be inserted in each service line as close as possible to the point of entry in any consumer's premises, and contained within a suitable locked or sealed receptacle of fireproof construction, except in cases where the service line is protected by fuses in a street box." A few other regulations having been discussed, the proceedings of the Conference terminated.

A RARE British bird invites the attention of ornithologists in the Fish House of the Zoological Society's gardens. This is a Spotted Redshank (*Totanus fuscus*) in winter plumage, recently obtained from the fens of Lincolnshire, being the first individual of this species that has been received by the Society.

IT is well known that liquid ammonia relieves the effects of the stings of bees. A correspondent informs us that a much more effectual antidote is the mixture known as ammoniated tincture of quinine. On several occasions, when stung by bees, he found that the quinine mixture would give much quicker and greater relief than ammonia alone.

WITH reference to their letter on the thermal conductivity of rocks, published in our issue of the 7th inst., Messrs. Peirce and Willson desire to say that the phrase "recent discussion in NATURE" refers to communications printed in these columns previous to June 20. When they wrote their letter, they had not seen the account of the experiments of Lord Kelvin and Mr. Murray, published in NATURE of that date (vol. lii. p. 182).

A CORRESPONDENT writes:—"On November 19 of this year, some yardsmen were turning over some English oak planks, prior to stacking them, at Messrs. Harry Hems and Sons at Exeter, when one of the men put his hand in a knot-hole that occurred in a 6-inch thick plank. He instantly withdrew it with a cry, and some wasps flew out. On examination, the hole was found to contain a large nest with sixty or seventy wasps in it. The plank and its living contents had come, with a number of others, from Lincolnshire by rail a few days before. Probably this long ride for a wasp's nest beats the record!"

SOME of the officers of the new Ashantee Expedition, who have leisure for sporting pursuits on their march up to Coomassie, will do well to secure for the National Collection additional specimens of the Royal Antelope (*Neotragus pygmæus*), which are much wanted. This little animal, discovered by Bosman in 1704, and named the "King of Harts," and subsequently figured in Seba's "Thesaurus," although so long known to science, is still a scarce object in our museums. In fact, as Messrs. Sclater and Thomas tell us in their "Book of Antelopes," all the small members of this group, both of West and East Africa, are still very imperfectly known, and additional specimens and information on them are much required.

IN the course of his researches on the smaller mammals of South America, Mr. Oldfield Thomas, of the British Museum, has made a brilliant discovery. A small rodent, not quite so big as a rat, which he has lately named *Cænolestes obscurus*, turns out to be closely related to, and a surviving representative of, some of the Fossil Marsupials recently described by Ameghino from the Santa Cruz beds of Patagonia. It therefore belongs to a new family, quite distinct from all hitherto known existing forms of the Marsupial order. Mr. Thomas's paper on this subject will be read at one of the Zoological Society's next meetings.

"CARBONIC snow," or carbonic acid crystals, form the subject of an interesting paper by MM. P. Villard and R. Jarry in the November number of the *Journal de Physique*. Using a toluene thermometer, they found that in the open air it kept at a constant temperature of $-79°$ C. This is in fact its boiling point, but whatever liquid is formed is at once frozen by the cold caused by evaporation. Hence the gas is only slowly given off. To prevent radiation, it should be kept in a glass silvered on the outside. The solid "snow" is, by the way, heavier than the liquid carbonic acid, in spite of its apparent lightness. No hoar-frost forms on the surface, owing to the constant evolution of the gas. Another vexed question is that of the temperature of the solution of the "snow" in ether. Accurate measurements showed that, contrary to the popular idea, this solution is not a freezing mixture, its temperature being $-79°$ C., the same as that of the solid. Methyl chloride does, on the other hand, form a freezing mixture of the temperature $-85°$ C. In a flat dish this becomes $-88°$ C., and when a current of air is blown through, $-90°$ C. In a vacuum of 5 m.m. of mercury, the temperature falls as low as $-125°$ C. Since this is below the critical temperature of oxygen, there seems no reason why oxygen should not be liquefied by the aid of carbonic acid alone.

THE common crow has a bad reputation among agriculturists, but a report, by Prof. W. B. Barrows and Mr. E. A. Schwarz, on his habits in the United States (*Bulletin* No. vi., U.S. Department of Agriculture), shows that even his character is not so black as it has been painted. The most important charges brought against the crow are that it pulls sprouting corn, injures corn in the milk, destroys cultivated fruit, and feeds on the eggs and young of poultry and wild birds. All these charges are sustained by the results contained in the present report of the examination of the contents of nearly a thousand Corvine stomachs. Crows do certainly feed upon the substances named, but the extent of the injury they do is quite another matter. In order to ascertain whether the sum of the harm done outweighs the sum of the good, or the contrary, the different kinds of food found in the stomachs have been reduced to quantitative percentages, and then compared. The results show that only 3 per cent. of the total food of the crow consists of sprouting corn and corn in the milk; the remaining 97 per cent. is chiefly waste grain picked up here and there, mainly in winter, and of no economic value. In the case of cultivated fruits, the loss due to crows appears to be trivial. The same is true of the eggs and young of poultry and wild birds, the total for the year amounting, in the cases examined, to only 1 per cent. of the food. As an offset to his bad habits, the American crow is credited with the good done in destroying noxious insects and other injurious animals. Insects form 26 per cent. of his entire food, and the great majority of these are grasshoppers, beetles, weevils, cutworms (larvæ of Noctuidæ), and other injurious kinds. To the same side of the scale must also be added the destruction of mice, rabbits, and other injurious rodents by the crow. Wherefore Mr. Hart Merriam concludes, in his introductory note to Messrs. Barrows' and Schwarz's valuable report, that, in summing up the benefits and losses resulting from the food habits of this bird, the good exceeds the bad, and that the crow is a friend rather than an enemy of the farmer.

THE efficiency of windmills and agricultural apparatus forms the subject of a note, by Prof. Cleveland Abbe, in the *Monthly Weather Review*. There are many important and expensive agricultural machines, such as reapers, mowers, windmills, and pumps, to say nothing of portable steam-engines, that are needed on large farms, or the centrifugal separators used in dairies, that fail to give satisfaction because of some inherent mechanical defect. The most efficient machine is that which produces the best result with the least possible waste of power. Prof. Abbe suggests that there be some recognised authority to come between the manufacturer and the farmer; some one who shall "standardise" any piece of apparatus when desired, and

certify as to the amount of power that is lost, or as to the efficiency of the machine when working under its best possible condition. Mechanical engineers are accustomed to determine very accurately the relation between the work done and the force expended; but no arrangement has yet been organised in America, though in England the Royal Agricultural Society does something by means of which the farmer may obtain, for a small fee, accurate information as to the efficiency of the windmills, pumps, and other apparatus used by him. Such tests are sometimes applied, but oftentimes imperfectly, to machines that are offered in competition for prizes at shows; but the results apply only to those specific samples, and not to others that are ordinarily found in the market. There are standards for the sale of illuminating gas, electricity, and other sources of energy. The time may come, concludes Prof. Abbe, when Governments will standardise and regulate the sale of the machines for the conversion of force or the doing of work.

THE current number of the *Journal de Physique* contains a description of an instrument for measuring the specific inductive capacity of liquids or solids, designed by M. Pellat. The instrument consists essentially of two Kelvin attracted disc electrometers, in which the two movable discs are rigidly connected together. The two attracting discs are in metallic connection, and one of them can be moved by means of a micrometer screw. The attracted discs are attached to the arm of a delicate balance, the position of the beam being observed by a microscope. An air damper attached to the beam serves to check the oscillations, which otherwise would render the measurements extremely tedious. Weights are used to roughly counterpoise the weight of the attracted discs when the whole instrument is at one potential. The final adjustment is made by means of a fine spiral spring, attached to the arm of the balance, and which can be stretched more or less by means of a micrometer screw. This spring has the advantage of increasing the range of potential difference over which the position of the balance is stable. The substance to be examined—if a solid in the form of a slab, or if a liquid contained in a glass dish—is placed between the fixed attracting disc and its movable disc, being supported on three small glass blocks which rest on the guard-ring. Readings of the position of the movable attracting disc are taken with and without the substance in place, and from the difference of the readings the specific inductive capacity is calculated. The sensitiveness of the instrument is such that the author has been able to measure, roughly it is true, the specific inductive capacity of mica, using a plate of this substance only 0·013 c.m. in thickness. In the case of liquids, measurements have been made in which the one set of plates, attracting plate, attracted plate and guard-ring, were entirely immersed in the liquid. The effect of capillarity on the stem joining the two attracted discs was to very much increase the range of potential difference giving stability of the balance. It was found that at the moment of applying the difference of potential an initial and very sharp movement always takes place when the balance is not perfect; so that the measurements could be made with an accuracy as great as in the case of solid dielectrics.

WE have received from M. A. Lancaster, of the Royal Observatory, Brussels, a pamphlet containing his communications to the Congress of the Science of the Atmosphere, held at Antwerp last year: (1) On synoptic weather charts, advocating the establishment of an international meteorological institute, acting on the part of all countries, and the publication of weather charts for extensive areas. The question of an international institute for meteorology has frequently been discussed, and at the recent meeting of the International Meteorological Committee at Upsala it was decided that the idea was not practicable. But the author points out that in the cases of geodesy and metrology such institutions have long been established. (2) On the nature of the wind. The principal object of this paper is to draw attention to the similarity of the views of the late M. Houzeau (formerly director of the Brussels Observatory) to those of Prof. S. P. Langley, expressed in his treatise on the internal work of the wind (NATURE, vol. xlix. p. 273), in which he shows that the wind consists of a succession of pulsations of very short duration, of variable amplitude and direction, relatively to the mean movement of the wind. (3) On the strength of the wind in Belgium. This paper contains tables of the principal results of observations at Brussels from 1850 to 1889, showing *inter alia* the mean monthly velocity, the bi-hourly variation, the maximum velocity and its direction in each month. These tables afford valuable information for architects and engineers, and for any one requiring details as to the effect of the motion of the atmosphere.

RESPONSIBLE measle-microbes, although suspected, have long eluded the diligent search of the investigator. Dr. Joseph Czajkowski, however, appears to have opened up the subject afresh by bacteriological researches which he has been carrying on for nearly four years on cases collected from four different epidemics of measles. Although the total number of cases bacteriologically examined was not great, amounting to only fifty-six in all, yet in every instance the same microbe was identified from the blood of measle patients, and is described as being a somewhat slender bacillus with blunted ends, producing occasionally threads in cultures some months old. No difficulty is experienced in staining it with the usual aniline colours, and in drop-cultures it is seen to be very motile. Gelatine and agar are not suitable for its growth; on the other hand, glycerin-agar and broth form convenient culture materials. As regards the pathogenic properies of Dr. Czajkowski's bacillus, the information is only at present limited to its action on rabbits and mice. The former experienced no inconvenience whatever after being inoculated with it, but the mice died in from three to four days, exhibiting symptoms of septicæmia, and the same bacillus was subsequently obtained in pure cultures from the blood, spleen, and liver of the infected animals. Perhaps the strongest evidence in favour of the author's researches is to be found in the fact that two other investigators, P. Canon and W. Pielicke, working at the subject quite independently of Dr. Czajkowski, discovered the same bacillus. Further inquiries must, however, be made before we can define with certainty the precise relationship to measles possessed by this new microbial claimant.

THE last number of the *Mittheilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten*, Bd. viii. Ht. 3, continues the scientific description of the German colonies. The first contribution deals with the Hinterland of the Cameroons, from materials collected during Dr. Passarge's expedition during 1893 and 1894. Schnauder has worked out a series of twenty longitudes. Passarge gives the data on which the altitude determinations rest, and some of the results. Dr. Limpricht has prepared three maps of the district on the scale of 1:350,000, and connected Passarge's routes with those of previous travellers in this region, viz. Barth, Flegels, Maistre, Zintgraff, and Baikie. The second contribution in the number is Stühlmann's description of the Uluguru Mountains, a district in German East Africa between Usambara and Usagara, and about one hundred miles inland. Geologically it consists mainly of gneiss, with some clay-slates, oolitic limestones and red sandstones, on the plains at the eastern foot of the mountains. Mica and graphite were the only minerals found, which Dr. Stühlmann thinks may be of economic value. The gneiss forms a plateau, to the east of which are the steppes of the "Vorland." The former is regarded as healthy and free from malaria. The author of this report has previously expressed the belief that

the climate of eastern equatorial Africa was more humid than at present; he now attributes the change to artificial deforestation of the country. The most interesting paper in the number is one by St. Paul Hilaire, which gives an account of the laws of inheritance of the different tribes on the coast near Tanga. In the actual coast towns the people are either Mohammedan, or under Mohammedan influence, and the author has little new to record, except a list of native writings. The Bantu people of the district considered belong to four tribes, of which the report deals only with the Wa digo, one of the most intelligent people on the East African coast. St. Paul-Hilaire first states the laws on the inheritance of property, which passes to the relatives of the mother. Thus a man's wives and children are inherited by the nearest male maternal relative. The rest of the report summarises the rules in regard to marriage. The last article in the volume continues the publication of Dr. Steinbach's important meteorological observations on the Marshall Islands.

FOR several years the American Public Health Association has had a special committee on pollution of water supplies. At the meeting of the Association in Montreal, this committee recommended that a co-operative investigation be instituted with regard to the bacteriology of water supplies, and, as an outcome of this proposal, a convention was held in New York, in June last, to consider methods and elaborate a standard scheme of work which would secure some sort of uniformity in the differentiation of species of bacteria. The verbatim report of the proceedings of this convention (which was attended by most of the prominent American bacteriologists), together with the papers presented, make up the October *Journal* of the Association. The subjects considered relate almost exclusively to certain technical matters, which required elucidation before a satisfactory scheme of work could be drawn up; among these questions being: colour nomenclature for bacteriologists; how variability is to be regarded; the methods to be followed in determining the relation of bacteria to temperature; methods for the separation of bacteria into groups, and for the identification of species; the nature of the flagella, and their value in the systematic classification of bacteria; the grouping of water bacteria, and the influence of variations in the composition of nutrient gelatine upon their development. No decision was reached on any of the questions discussed; but the whole series was referred to a committee, with the understanding that the convention would accept its decision, and that its members would modify their laboratory methods in accordance therewith. The decisions of this committee have not, however, yet been published.

THE literature of marine biology has just been increased by the publication of the fourth volume of "Reports upon the Fauna of Liverpool Bay and the neighbouring Seas," written by the members of the Liverpool Marine Biology Committee and other naturalists, and edited by Prof. W. A. Herdman, F.R.S. The volume commences the record of the investigations carried on at the committee's biological station at Port Erin, Isle of Man. At this station, which was opened in 1892, several important investigations have already been carried out, and there is every reason to believe that the work will develop in the future, as the facilities for observations are increased. We notice among the papers included in the volume, one on the vascular systems of the Starfishes, by Mr. H. C. Chadwick, and another on the Cerata of Nudibranchs, by Mr. J. A. Clubb. There are also reports on Turbellaria, by Mr. F. W. Gamble; on Copepoda, by Mr. Isaac C. Thompson; on Nemertines, by Mr. J. H. Vanstone and W. I. Beaumont; on Medusæ, by Mr. E. T. Browne; and on Amphipoda, by Mr. A. O. Walker. These, with a valuable paper, by Dr. R. Hanitsch, on the nomenclature and classification of British sponges, and three reports, by Prof. Herdman, upon the work of the Liverpool Marine Biology Committee and their biological station, make up a very creditable volume. The Liverpool naturalists deserve to be congratulated for accomplishing so much work in a modest establishment, and without any funds except those raised by private subscriptions.

TWO memoirs on Entomophytes have recently been published. The one is by Mr. R. H. Pettit on "Studies in Artificial Cultures of Entomogenous Fungi," and emanates from the Cornell University Agricultural Experiment Station, U.S.A. The other is by Mr. A. S. Olliff on "Australian Entomophytes, or Entomogenous Fungi, and some account of their Insect-Hosts," and is issued by the Department of Agriculture, Sydney, N.S.W. Both are well illustrated, and deal largely with Cordyceps and Isaria. The loose, white, cottony growth which sometimes envelopes dead insects is a familiar sight, and Mr. Pettit, in discussing the possible use of entomogenous fungi for insecticidal purposes, refers to the suggestion that has been made to employ *Sporotrichum globuliferum* against the chinch-bug. Mr. Olliff is prepared to make the assertion that all the larger fungi of the genus Cordyceps live upon, and at the expense of, subterranean larvæ and pupæ, in proof of which he points to the fact that all the bulky species of which the hosts are definitely known have been found upon root-feeding insects. Of Hyphomyceteæ there are various minute entomogenous forms recognised as Australian. Some of these are variously found on aphides infesting pumpkin leaves, on dead ants, and on red scale of the orange. *Botrytis tenella*, Sacc. (*Isaria densa*), on larvæ and pupæ of Diptera, wasps, and cockchafers, has been introduced into Australia from Europe for the purpose of killing Lamellicorn larvæ, but the attempts have not succeeded. Mr. Olliff adds that in view of the large numbers of *Cordyceps Gunnii*, and *C. Selkirki* that are found in a limited area, and of the extensive injuries to useful timber and shade trees which often result from the attacks of the subterranean larvæ of Pielus and Trictena, the hosts of these parasitic fungi, it is evident that the native species of Cordyceps have a considerable economic value. He hopes that the Department of Agriculture at Sydney will shortly be able to make investigations to test the possibility of utilising these fungi artificially for the destruction of injurious root-feeding insects.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. V. Roger; a Smooth-headed Capuchin (*Cebus monachus*) from South-east Brazil, presented by Major F. A. White; a Kittiwake (*Rissa tridactyla*), British, presented by Mr. Walter Butters, jun.; three Poë Honey Eaters (*Prosthemadera novæ-Zealandiæ*) from New Zealand, presented by Mr. Morton Campbell; a Bearded Lizard (*Amphibolurus barbatus*), a Diamond Snake (*Morelia spilotes*) from Australia, presented by Mr. Frederick G. Aflalo; a Four-lined Snake (*Coluber quadrilineatus*), European, presented by Captain Allen Keys; a Poë Honey Eater (*Prosthemadera novæ-Zealandiæ*) from New Zealand, deposited.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A bright comet was discovered by Mr. Brooks, at Geneva, on November 21, in R.A. 9h 52m. and Decl. 17° 4′ S. An observation of the comet at Copenhagen shows that it is moving northwards at the rate of nearly three degrees per day. On November 24, at 17h. 37m. 9s., it was in R.A. 9h. 42m. 33s. and Decl. 10° 40′ 32″ S. The comet is not far from α Hydræ, and rises about 12.30 a.m.

COMET PERRINE.—The comet discovered by Mr. Perrine at the Lick Observatory, on November 16, was observed by Dr. Lamp at Kiel, on November 18, its position at 17h. 34·2m. Kiel mean time being R.A. 13h. 48m. 8s., Decl. 0° 50′ 24″ N. *Edinburgh Circular* No. 47 reports that the comet was also

observed by Dr. Halm, at Blackford Hill, as follows:—November 18, 18h. 26m. 14s. G.M.T.; R.A. 13h. 48m. 15s., Decl. 0° 48′ 18″·8 N. The movement of the comet is in a direction south-east by east, and it now rises about 4 a.m. Dr. Lamp states that the comet is moderately bright, but not visible to the naked eye; it is round, with a central condensation, and a straight tail (*Ast. Nach.* 3318).

VARIABLE STAR CLUSTERS.—Harvard College Observatory *Circular*, No. 2, announces that an extraordinary number of variable stars has been discovered in certain globular clusters which have been photographed by Prof. Bailey at Arequipa with the 13-inch Boyden telescope. At least eighty-seven of the stars in the cluster M3 (N.G.C. 5272), in Canes Venatici, have been found to be variable, and in some cases the change of light amounts to two magnitudes or more. In the cluster M5 (N.G.C. 5904), forty-six variables were found, out of 750 stars examined, so that they form about six per cent. of the whole; of the sixteen stars, contained in a circle 110″ in diameter, six are variable. Smaller numbers of variables have been found in other clusters, but in other cases not a single variable has been detected out of the hundreds of stars which have been photographed; the conditions of the search, however, not taking account of long period changes. In general, no variables have been found within about one minute from the centres of the clusters, on account of the closeness of the stars, and none are more than ten minutes distant from the centres. Some of the newly-discovered variables have short periods, in some cases of only a few hours. Thus, five photographs of N.G.C. 5904, taken at intervals of an hour on July 1, 1895, give for the magnitude of a star about three minutes of arc preceding the centre of the cluster, 14·3, 13·5, 13·8, 13·9, and 14·3; four plates, taken at similar intervals on August 9, gave the magnitudes 14·2, 14·6, 14·8, and 15·0.

ON A METHOD OF PHOTOGRAPHY IN NATURAL COLOURS.[1]

IN 1861 Clerk Maxwell described a method of colour photography, based upon his experiments on the theory of colour vision, and made the following experiment. Three photographs of a coloured object were taken through three several coloured solutions giving images which separately represented the object as it would be seen by each of the three sets of colour nerves postulated by Young. When these were superposed the original colours of the object were reproduced, save for the defect that the red and green components suffered from the insensitiveness of the photographic plate of Maxwell's time to the longer wave-lengths. Maxwell added the remark that when the photographic plate was improved as regards sensitiveness to the less refrangible rays, the representation of colour would be improved.[2]

Since Maxwell's day the colour blindness of the plate has been almost completely remedied, thanks to the discovery of Vogel, and it is now possible, proceeding on the lines laid down by Maxwell, to produce by triple projection upon the screen a picture which may be illusively like nature. For the application of modern resources and the suggestion of photographing to the colour vision curves by special colour screens, we have to thank Mr. Ives.

Composite colour photography deals with the subjective reproduction of all visible wave-lengths in two stages; a photographic analysis and an optical synthesis. In the first operation the several wave-lengths are caused to produce three separate photographic images according to their physiological activity in exciting the supposed fundamental red, green, and violet sensations. That is, if the image bears, for example, a yellow colour (suppose such a yellow as the spectral yellow near the D line), one of the plates must record an image of the object having a density of silver deposit corresponding to the degree in which this wave-length can excite the red-seeing nerve, and a second must acquire a density corresponding to the degree in which this same wave-length can excite the green-seeing nerve. The third plate records no impression, for the wave-lengths near D excite no violet sensation; but this yellow sensation is the resultant of two physiological effects only, a red and a green sensation in certain proportions obtained by colour measurements effected upon normal colour sight. We have now obtained three negatives possessing densities of silver deposit corresponding to the degrees in which the three several fundamental colour sensations are stimulated. These degrees of density will be interpreted as degrees of transparency in the positives. The first positive, if backed with a red glass, will transmit a quantity of red light corresponding to the intensity of the physiological excitation of redness in the "red" nerves; the second, backed with green, similarly represents the stimulation of the "green" nerves by the yellow colour of the object; the third positive is backed with blue-violet glass, but is quite opaque, and no violet light is transmitted through it. The projection now of all three images superposed upon the screen forms the second stage of the procedure; the optical synthesis of the original colours. The eye regarding the superposed image receives, in fact, the same amounts of red and green sensation, and experiences the same absence of violet sensation which would have attended the formation of the image of the original object upon the retina.

This process, if accurate reproduction of colour is sought, necessitates the use of two distinct sets of colour selective screens; for the analysing screens will by no means possess the tints ultimately required in the optical synthesis. This is evident since the measurements on colour vision reveal that the wave-lengths near D are more strongly stimulative of red sensation than are the purely red exciting wave-lengths near C, and the wave-lengths again diminish in their power of producing stimulation of the "red" nerves on the more refrangible side of D. Hence, in order to photograph the wave-lengths of the spectrum, we require to produce a greater photographic effect by the D wave-lengths than by the C wave-lengths, and a photographic

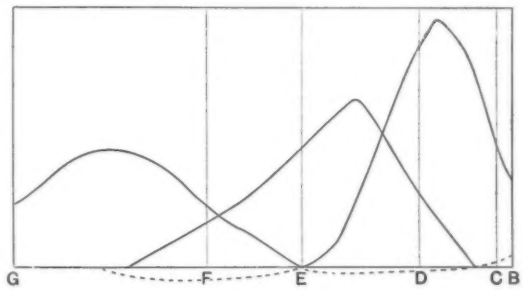

FIG. 1.

effect diminishing above D in the same degree as the power of the waves to excite the fundamental red sensation diminishes. To effect this analysis of the light a screen transmitting as predominant wave-length, a wave-length near D must be used for obtaining the image which is to represent the appreciation of light peculiar to the "red" nerves. Such a screen has a yellow-orange colour, which is not the sensation excited in or transmitted by the "red" nerves. In the optical synthesis this must afterwards be represented by a C red colour. The same remarks apply to the other screens.

Maxwell's curves (Fig. 1) are not colour sensation curves (Abney: "Colour Vision," Tyndall Lectures, 1895), and it is misleading to speak of the foregoing method as effected on colour sensation curves. Maxwell's curves represent, in fact, the subjective synthesis of the spectrum out of three chosen wave-lengths—a red, a green, and a blue-violet. The question as to how far one or all these chosen wave-lengths may excite more than the one set of nerves remains over, and indeed can only be gone into by examination of abnormal colour vision. In Kœnig's curves of colour vision, colour sensations are plotted. These are shown in the named curves of Fig. 2.

If, from the knowledge afforded by Kœnig's curves of the compound nature of the green sensation, Maxwell's curves be examined with reference to their suitability to serve the purposes of the photographic method, it will be found that, assuming Maxwell's E green to excite the proportionate amounts of red and violet sensation revealed by Kœnig's curves, a correct synthesis of the F green by Maxwell's curves is impossible. Although such a comparison is not strictly allowable owing to

[1] Abstract of a paper read before the Royal Dublin Society, by Dr. J. Joly, F.R.S.

[2] "On the Theory of Three Primary Colours." "Collected Papers," p. 449.

the red and violet curves of Maxwell being based on different wave-lengths to those used by Kœnig, the fact of grave inaccuracy is certain. This fact will appear if the spectrum is photographed according to Maxwell's curves. The blue-green will then be found to be reproduced too yellow in tone.

In order to apply the colour sensation curves of Kœnig to the photographic method, we have to find by trial examinations of his curves the green most suitable for backing the "green" positive; for we see that the several green wave-lengths excite very different amounts of red and violet sensation. We find as suitable a wave-length a little to left side of the E line, about 550 $\mu\mu$. If we take this colour to back the green positive, we must, in order to find the correct red and violet curves which are to control the densities of the red and violet images, replot the red and violet curves with allowance for the proportionate amounts of red and violet which will be carried to all those points where in the image of the spectrum the green curve operates. The red and violet curves must be lowered by amounts obtained by ascertaining from the height of the green curve at any point the amount of red and violet sensations excited by the amount of our selected green present at that point. The final curves are shown in the slightly altered violet sensation curve, the original green sensation curve, and the considerably lowered red-mixture curve (as it may be called); the full line in all cases representing the applicable curves. It is seen that the amount of negative colour (which cannot be realised) is small. Although it is possible that the compound nature of our green sensations will deny absolute accuracy to this method of colour photography, still my own results on the curves just described, and the results of Ives and others on modified Maxwell curves, appear to show that a degree of

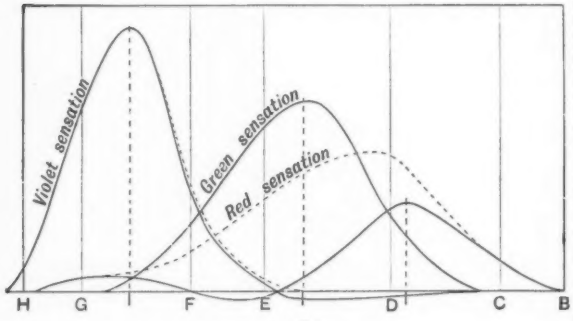

FIG. 2.

accuracy baffling the criticism of the ordinary untrained eye may be attained, and that in the reproduction of the most complex tints.

The symmetry of the derived curves renders their application easy. The transmission of light through a pigment is not limited generally to a small group of predominant wave-lengths, but falls off uniformly at either side in the directions of longer and shorter waves. If we choose the pigments used on the analysing screens so that their predominant transmissions are at three points in the spectrum indicated by the axis of symmetry of the three curves, these being nearly symmetrical, very accurate results are obtained. The positions of these axes of symmetry are shown by the vertical dotted lines. Accordingly, I make the colour of the red-taking screen that of the spectrum at a point displaced to the red side of D by about one-sixth the interval D to C; for the green and violet-taking screens the correct tints are found in the same manner by scaling from the figure. Good results are thus obtained, but I do not assert that these details of procedure are final.

Any method of photography in natural colours must possess the characteristics not only of accuracy of colour rendering, but also of convenience of application and permanency of colour, if it is to possess value as a scientific method. For use under the various circumstances of travel the naturalist requires a method no more cumbersome than the present dry plate. In the method of composite colour photography, as described, the ordinary camera will not serve. The cumbersome necessity of obtaining three images remains, and subsequently no concrete image in natural colours is actually obtained. One can only be realised by triple projection upon a screen, or by using some optical contrivance which, by the aid of reflectors, enables all three images to be simultaneously projected upon the retina.

I now proceed to describe a mode of applying the foregoing principles which is free of the objection of cumbersomeness, and which enables us to realise a concrete image in transparent colours. A plate is finally produced which may be held in the hand, regarded against the light, and which bears an image of the object in natural colours, or such as are so nearly accurate as to seem so to the eye. In this new method there is but the one image photographed. The ordinary camera, lens, and backs, &c., are used without modification. The first-class isochromatic plates in the market, which are sensitised down to the C red, will give very good results.

In the new method the idea is to carry the application of physiological principles still further, and divide up the plate like a hypothetical subdivision of the retina, so that all over the plate there should be minute regions uniformly distributed wherein the sensitive silver salt is excited to become reduced to the "photogenic" material in the same degree in which the sensations of redness, greenness, violetness, would have been actually excited in the several nerves of the retina had the image been formed upon it. Development builds upon this photogenic material the denser silver deposit, and ultimately in the positive the amounts of the sensations are registered in the degrees of transparency of the successive regions. The lined screen which can bring about this I can show you in the microscope. It consists of closely ruled adjacent lines in orange, green and violet tints. This screen, applied closely to the sensitive surface, analyses the image in the camera. The screens I have used hitherto are coarse, about 200 lines to the inch, and even with this coarseness will show plainly, I regret to say, the imperfections of the only apparatus at my command in preparing these screens. I may observe, in passing, that the colours are ruled on in pigments made up as inks in gelatine and gum arabic or dextrine, and upon plates coated with a preliminary layer of gelatine. Such lines may be put on so close as 800 or 1000 to the inch. With between 300 and 400 to the inch, however, the eye is no longer annoyed by the structure of the plates. The lines may also be ruled on celluloid or on translucent paper.

The appearance of both negative and positive obtained is interesting. One would hardly at first sight distinguish between them and the ordinary images. But a lens readily shows the difference. Recalling now that the lines upon the positive register in their degrees of transparency the degrees in which the three-colour sensations would have been excited, it becomes apparent that to complete the physiological parallel we must convert these degrees of transparency to quantities of the red, blue and violet colour sensations. This is done by a second screen, which carries red, green and violet lines to the same gauge as the taking screen. We apply this to the positive, and as we move it over the image, waves of every tint of colour appear till that position is reached where the red lines fall over the lined areas recording red sensation, and so for the others. The picture now suddenly appears in vivid colour and with all the realism and relief conferred by colour perspective.

A picture of wallflowers taken through a dichromatic screen, the red and green sensations only being photographed, is of interest as realising the appearance of the object to a violet-blind eye. The rich reds and browns appear unaffected; the greens are, however, somewhat unnatural. A photograph of the spectrum shows the range of colour from the C red to the H lines. The blue-green is, however, defective. It was taken according to Maxwell's curves. Photographs of burnished metallic objects, as a brightly lacquered microscope, reproduce the metallic lustre; and one of an uranium glass bowl, reproduces the characteristic dichroism and fluorescent appearance of the glass when seen by daylight. That every shade of colour can be reproduced, however complex, is shown by two portraits, one from life, and one a copy of a water-colour drawing boasting very æsthetic shades of brown and olive. A great variety of bright sunlit colours appear in a view at the Trinity College athletic sports, wherein the scarlet uniforms of the military band, the green of the grass, and the blue sky, recall the vivid appearance of the image on the ground glass screen of the camera. The colour perspective in such pictures adds greatly to the reality and relief. The faithful reproduction of texture, as in the case of some pansies, where the velvety browns and purples of the originals reappear, or as in the case of the wallflowers, reminds us how much is

inferred from the most subtle differences of light and shade in the colours of objects, in association with previous experience derived through other senses. The picture is always an optical illusion; and this additional illusiveness conferred on the photograph by the method invented by Maxwell on the basis of the three-colour theory of vision, is surely a strong confirmation of that theory.

These results are attained by no new photographic operations. It is necessary to use good orthochromatic plates sensitised into the red, and also to have affixed in the lens an orthochromatic screen cutting of the ultra-violet light in the usual manner. The exposure is somewhat longer than the ordinary exposure, for we can of course only use visible light, and of this a part is stopped by the taking screen. The ordinary backs may be used. The displacement of the sensitive film from accurate register with the ground glass camera screen, owing to the presence of the taking screen in front of it, may be corrected (if thought necessary) by simply reversing the surface of the ground glass camera screen, turning the muffled side outward. This secures that the image will be accurately focussed in the plane of the sensitive surface. Negatives and positives may be used as ordinary negatives or positives till it is desired to recall the original colours. Thus, for those who wander with the camera, the possession of but the one seeing screen to test results is sufficient, and of course the one taking screen suffices to take an indefinite number of plates.

These considerations lead us naturally to observe that the registration of colour being really carried in the silver image, which with very little care in manipulation may be made permanent, secures that the colours are permanent. A faded screen may at any time be made good by a fresh screen; the colours in all cases being spectroscopically chosen, we are assured of the reproduction of the original colour. In this aspect the necessity of the detached colour screen is no disadvantage, but rather a necessary safeguard against the inevitable fading attending most pigment colours.

COMET MAGNITUDES.

DR. HOLETSCHEK, of the Vienna Observatory, has recently communicated to the Imperial Academy of Sciences a paper on the magnitude and brilliancy of comets and their tails, with the view of arranging them in "magnitudes" or orders of brilliancy in a manner similar to that in which stars are arranged according to their lucidity. Further, from the data given as to the apparent length of the tail, the true length of the tail has been computed, and an inquiry instituted as to the possibility of tail formation and its probable length, based on the resulting magnitude of the comet and its perihelion distance.

If it be true that the brilliancy of a comet varies as the squares of the distances from the sun (r), and from the earth (Δ), then from observations made at various points of the orbit, the same "magnitude" ought to result for the values $r = \Delta = 1$. This magnitude Dr. Holetschek has deduced, where sufficient data existed, and the results can be practically arranged in two classes: one, in which the deduced magnitudes derived from various values of r and Δ so nearly agree that a mean can be taken; the other, in which is shown a regular progress, and always in the direction that the deduced magnitudes with small radii vectures, therefore when the comet is near perihelion, are greater than when at large distances from the sun. The origin of this is due to the fact that the second power of the radius vector does not fully represent the variations occurring in comets as they approach the sun, at which time their brilliancy is more increased than is shown by the ratio $1 : r^2\Delta^2$. The first case, it is suggested, is only a special case of the second, arising through insufficiency of description. This is most clearly shown when the time covered by the observations is short, or the details so wanting in accuracy that the deviation from the ratio $1 : r^2\Delta^2$ cannot be known with certainty. The conclusion drawn is that the formula so generally used can represent the brilliancy of a comet at different distances from the sun for a short time only, and is inapplicable for long periods.

Dr. Holetschek uses the deduced magnitude in the neighbourhood of the perihelion, valuable as showing the greatest brilliancy attainable in a particular comet, as the data for forming the comets into orders of magnitude, and inquires how far the tail formation is connected with this magnitude and the perihelion distance. He decides from his material, that when the deduced magnitude is 6 or lower than 6, only a short and feeble tail, or one not visible to the naked eye, is possible. Comets with a deduced magnitude of 4, or still brighter, have a tail well visible, which is the greater, the smaller the perihelion distance, and the smaller, the greater this distance. Within the limits between 4 and 5 magnitude, if we exclude very great perihelion distances, lie the possibilities of a considerable tail development.

Dr. Holetschek has also considered the diameters of comets, and sought to introduce order by reducing the apparent diameter to that corresponding to a distance of the comet from the earth equal to unity. In the case of Halley's comet, no diminution or variability is to be detected in either its brilliancy or the length of its tail. The same values serve from 1456 to 1835. As, however, on account of the continual development of the tail, a diminution of the mass is probable, it cannot be decided whether the approximate constancy, shown in the investigation, arises from inadequacy in the observations themselves, or is produced by certain processes existing in cometary bodies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The delegates of the Common University Fund have elected Mr. Edwin Stephen Goodrich, Merton College, to the Biological Scholarship at Naples for the year 1895-96.

CAMBRIDGE.—The report to the Senate of the Engineering Laboratory Syndicate, dated November 9, 1895, is a very satisfactory record of energetic work. The University was unable to provide more than £1000 for the building and equipment of the laboratory, which was estimated to cost about £5000. By steady and enthusiastic efforts Prof. Ewing and his colleagues succeeded in collecting from many sources, within and without the University, the £5000 that were needed; and what is still more to their credit, have completed the work in hand with a small balance to the good. The continued growth of the department, in which there are now eighty-five students under instruction, makes a further extension of the buildings urgently necessary. A site has been provided for the purpose, but further funds are needed for construction. The workshops, never intended to be other than temporary, must soon be rebuilt, and more lecture-room accommodation must be provided. The department has certainly justified its existence, and the Syndicate have proved themselves to be worthy stewards of the funds placed at their disposal. It is to be hoped that, with these guarantees that they will be well used, the needful moneys may ere long be forthcoming. The valuable services of Mr. Dalby and Mr. Lamb, the demonstrators of mechanism and engineering, in the work of organising the laboratory, are mentioned with cordial appreciation in the report. Among the donors of contributions of over £100 are the Duke of Devonshire, the late Earl of Derby, Mr. Frank McClean, and Dr. John Hopkinson, and eleven benefactors have given £100 each. Valuable donations of apparatus and of books have helped greatly towards the furnishing of the laboratory.

The amount, clear of all expenses, available for the Robertson Smith memorial, is £1450. It has been agreed by the subscribers that sufficient of this amount should be invested to produce an annual income of £30, such income to be employed on the continuance and extension of Prof. Robertson Smith's library, which he bequeathed to Christ's College. It was also resolved that the remainder of the amount collected, after all expenses have been paid, be handed over to the University for the purchase of Oriental MSS. for the University Library, which shall be marked as having been acquired by means of the fund. It is estimated that about £300 will be handed over to the Syndics of the Library.

IT is reported that Mr. P. N. Russell has given the sum of £50,000 to endow a school of engineering in connection with the Sydney University.

AN address on the present state and position of technical instruction in this country, delivered by Major-General Sir John Donnelly before the Society of Arts on Wednesday, November 20, is printed in full in the current *Journal* of the Society.

THE annual meeting of the National Association for the Promotion of Technical and Secondary Education, and the Conference of Representatives of Technical Education Committees, will be held on Tuesday, December 10, at the Royal United Service Institution, Whitehall.

THE following announcements are made in the *Johns Hopkins University Circular* (No. 121):—Sir Archibald Geikie has accepted the invitation of the President and Board of Trustees of the Johns Hopkins University to inaugurate the George Huntington Williams Memorial Lectureship, and has selected October, 1896, as the time for delivering his lectures.—Prof. Cleveland Abbe, of the United States Weather Bureau, will, during January next, give four lectures upon Climatology in its relations to Physiography.—Mr. G. K. Gilbert, of the U.S. Geological Survey, will begin a course of lectures upon Physiographic Geology the second week in January, and will lecture four times weekly until about the end of February.—Mr. Bailey Willis, of the U.S. Geological Survey, will commence his lectures upon Stratigraphic and Structural Geology, as soon as Mr. Gilbert has completed his course, and will lecture twice weekly until the middle of May.—Dr. R. M. Bagg has been appointed assistant in Geology.

SIR JOHN GORST, in a speech delivered last Thursday at the annual meeting of the London Society for the Extension of University Teaching, remarked that "though they were all anxious that the scientific education of the country should be fully developed, it would be a great mistake if that development were to take place at the expense of the literary side of education. A proper liberal education is fairly balanced on all sides, and no system which extends one branch of education at the expense of others can be productive of anything in the long run but mischief." Just so. We have always urged that science should receive as large a share of attention as literature in our colleges and universities; but no one can say that it does. Some of Sir John Gorst's hearers took his remarks to indicate a reaction against the increased facilities now being offered for instruction in science; but if the remarks are taken literally, they mean that scientific education should be fostered, and placed upon the same footing as the humanities.

SCIENTIFIC SERIALS.

American Meteorological Journal, November.—Relations of the Weather Bureau to the science and industry of the country, by Prof. W. L. Moore, Chief of the Weather Bureau. It is satisfactory to find that the change of Chief will not affect the scientific activity of the U.S. Weather Office, as many people supposed. Prof. Moore quotes the Act of Congress of October 1, 1890, which prescribes the duties of the Chief, from which it is seen that the main object of the Bureau is to give warning of the approach of storms, and therefore that the proper line of investigation should be relative to their mechanism. Systematic exploration of the upper air, with a continuation of the studies of terrestrial magnetic forces, begun by Prof. Bigelow, will be the line of investigation prosecuted during the next two years. With regard to estimating the probability or severity of frost, Prof. Moore thinks that sufficient weight has not yet been given to the dryness or wetness of the soil, and he calls for special attention to this point.—The meteorological observatory on Monte Cimone, Italy, by A. L. Rotch. Monte Cimone is the culminating point of the Northern Apennines, attaining a height of 7100 feet above the sea, and it is the only summit station in Italy, the observatories of Vesuvius and Etna being both situated on the flanks of these volcanoes. Both the summit and base stations are provided with self-recording instruments, and are dependent upon the Central Meteorological Office at Rome, with which there is telegraphic communication.—Physiological effects of high altitudes, by A. L. Rotch. The author points out the importance of the effect of the rarefaction of the air on the human system, which is, as yet, but imperfectly understood, and refers to his own experiences at great heights in the Alps and Andes.

Wiedemann's Annalen der Physik und Chemie, No. 10.—The practical use of Wheatstone's bridge, by F. Kohlrausch. The meter bridge is greatly improved and made more sensitive by introducing two resistances, 4·5 times the resistance of the wire, at one or both ends of it. The wire may also be rolled on a roller of marble or wood boiled in paraffin, with a flat spiral groove. With an enlarged scale reading to thousandths the author claims to have attained a limit of error of 1 in 25,000.—Density measurements of extremely dilute solutions, by the same author. These were made, as before, by weighing a glass sphere immersed in the liquid. But as the sphere used was heavier in this case, the cocoon fibre suspending it had to be replaced by a fine wire of dull platinum. The accuracy was then carried to the seventh decimal place, the only limit being the accuracy of temperature measurements.—Luminescence of solids and solid solutions, by E. Wiedemann and G. C. Schmidt. This is a continuation of previous researches on photo-luminescence and cathodo-luminescence, or the phosphorescence produced by the impact of light and cathode rays respectively on certain bodies, such as sulphates. A list of the most brilliantly luminescent substances is given, including "solid solutions," in van 't Hoff's sense, of $MnSO_4$ in other sulphates. The kind of luminescence of the latter depends only little upon the concentration, but much upon the kind of solvent. The lower the temperature the brighter the light. But the sulphates of copper, iron, and nickel extinguish it altogether, even in small quantities. The spectrum of the rays emitted is in every case a continuous spectrum consisting of one band.—On the absorption of cathode rays, by P. Lenard. The ratio between the absorptive power and the density is the same for all media, whatever their state of aggregation, provided the cathode rays are of the same kind.—Cathode rays and continuous discharges in gases, by O. Lehmann. This paper deals with the question of the actual nature of gas discharges.—The cooling effects of air currents, by A. Oberbeck. These are measured by finding what velocity of air is required to prevent the glowing of a platinum wire conveying a current. It is proposed to use this as a sensitive anemometer.—Anomalous dispersion curves, by A. Pflüger. Cyanine and Hofmann's violet have refractive indices below 1 for rays between F and G, and fuchsine, magdala red, and malachite green all show an increase of refrangibility with increase of wave-length in certain portions of the spectrum.

Bulletin de la Société des Naturalistes de Moscou, 1894, Nos. 3 and 4.—On the Ostracodes fauna of the neighbourhoods of Moscow, by A. Croneberg (in German). Twenty-three species are described, of which *Cyclocypris pygmæa* and *Erpetocypris peregrina* are new (with plates).—On the slates of Megalo-Aïalo, near Balaklava, by D. P. Stremoukhoff (Russian, summed up in French). The presence of a number of Amonites, characteristic of the Bath and Kelloway strata, settles their age.—The birds of the government of Moscow, by Th. Lorenz. A list (in French) continued from a previous number.—The development of the tarsus in *Pelobatus fuscus*, by M. Chomiakoff (in German).—Two new Aphides from South Russia (*Stomaphis Graffii* and *St. macrohyncha*), by N. Cholodkovsky (in German). The microscopical structure of the electrical organ of the torpedo, by N. Iwanzoff, a large detailed work (in German), with plates in both numbers.—Yearly report of the Society.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 22.—Special meeting.—Captain W. de W. Abney, President, in the chair.—The following resolution, with reference to the articles of association, was passed. In Article 33, to strike out the words "by the payment of £10 in one sum," and in place of this to insert the words "the composition fee shall be, for every member who shall not have paid ten annual subscriptions, fifteen times the amount of the annual subscription payable by such member, and for any member who shall have already paid ten or more annual subscriptions, ten times the amount of the annual subscription payable by such member."—The ordinary meeting then took place.—Dr. G. Johnstone Stoney exhibited a print of Profs. Runge and Paschen's photograph of the spectrum of the gas obtained from clevite, together with a diagram illustrating the manner in which these observers have arranged *all* the lines obtained in two sets, each set containing three series of lines. Dr. Stoney also drew attention to the resemblance between each of these sets of three series of lines and the similar triple series obtained in the case of the metals of Mendelejeff's first group. The lines of the different series in the case of the gas obtained from cleveite have certain definite peculiarities which permit of their identification and selection. The two gases, to the presence of which the two sets of lines are presumably due, can be partly separated by diffusion through a plug of asbestos. Prof. Ramsay's observation that by suitably altering the pressure of the gas the predominance of the lines in either of the two sets can be increased is, however, against the

theory that the two gases are really separated by diffusion. Three of the original negatives taken by Prof. Rowland when preparing his map of the solar spectrum were also exhibited. Dr. Gladstone said he had examined the spectrum of the gas in two tubes, one of which had been filled by diffusion through an asbestos plug, and the helium line (D_3) was certainly brighter in one tube than in the other, though the brightness of the remaining lines appeared about the same in both tubes. As to the difficulty of allocating the new gases in Mendelejeff's table, it appeared to him (Dr. Gladstone) that they would have to be put in the first group between hydrogen and lithium. An examination of the successive differences between the atomic weights of adjacent members of the metals in the first group showed that these differences increased as we go downwards. If then the new gases have atomic weights of, say, 2 and 4, we should have for these differences 2, 2, 3, 16, 16, 26, &c., instead of 6, 16, 16, &c., as at present. The important point which required investigation was whether these two gases were really simple bodies or not. Prof. Silvanus Thompson asked if Runge and Paschen had performed a similar analysis of the lines in the spectra of other elements besides the members of the first group. He would also like to know if in the case of any element besides hydrogen the lines could be arranged in a single series. Dr. Stoney, in reply, said that the spectra of most of the metals had been analysed, the chief exceptions being iron, nickel, cobalt, and manganese. There was no other element besides hydrogen which gave a single series of lines. Prof. Herschel gave an account of a line of reasoning which had led him many years ago to a formula resembling that expressing Balmer's law for the hydrogen lines, namely, $\frac{1}{\lambda} = 1 - \frac{4}{n^2}$. The Chairman (Captain Abney) drew attention to the fact that Runge expressed his result to 1/1000th of an Angström unit, although Dr. Stoney had said the measurements could only be made to within 1/50th of a unit. There was great lack of uniformity in the method of drawing spectra in general use; he strongly recommended the placing of the red end of the spectrum to the right, so that the wave-lengths increased from left to right. As to the three series of lines obtained in the case of most elements, it was not conclusively proved that they were not due in each case to three distinct kinds of molecules, and it will probably be found that there are more than two simple gases present in the gas evolved from cleveite.—Mr. R. Appleyard read a note on the action of sulphur vapour on copper. When a copper wire is exposed for some time to the action of sulphur vapour, it becomes entirely converted into sulphide of copper, and it is found that there is a fine axial hole running down the rod of sulphide formed. Rods of copper of square section cut from a block of copper after exposure to the action of sulphur vapour also exhibited the axial hole, the rod of sulphide formed being of circular cross-section. In every case the diameter of the rod of sulphide is about twice that of the original rod of copper. Delta metal was found to be unacted upon by the sulphur vapour.—Mr. Appleyard then read a paper on a "direct-reading" platinum thermometer. This form of platinum thermometer has been devised with the view of determining the temperature of the dielectrics employed in some experiments on the variation of the electrical resistance of dielectrics with temperature. The thermometers consist of six platinum coils, each of about seven ohms resistance, attached to thick copper leads. A slide-wire Wheatstone's bridge is employed to measure the resistance. The stretched wire is three metres long, and the moving contact so arranged that it is impossible to damage the wire. The auxiliary coils used in connection with the bridge are immersed in a bath of paraffin oil, the temperature of which is maintained constant, and a little above that of the air, by means of a glow-lamp immersed in the oil. Mr. Appleyard also read a historical note on resistance and its change with temperature, in which he showed that the earliest measurements of the variation of resistance with temperature were made by Lentz in 1833. Some experiments on this subject made by Davy were also referred to, and some of these experiments repeated before the Society. Mr. Trotter said he agreed with the author, that the "reserve of precision" at our disposal, on account of the delicacy of some of the modern instruments, ought to be made use of to facilitate the rapid performance of many measurements where the utmost accuracy is not necessary. He had the impression that platinum silver was not now considered the best material for use as the bridge wire. Mr. H. F. Burstall explained the differences between the temperature as measured on the mercury, air and platinum thermometers. At a temperature of about 40° the platinum thermometer read about 0°·4, and the mercury thermometer about 0°·1 below the air thermometer. Prof. Callendar had obtained measurements of temperature correct to within 0°·1 by using a Weston voltmeter and an ordinary Wheatstone bridge the variations of resistance, and hence the temperature being read directly from the deflections on the voltmeter. Mr. Rhodes thought that, except where extreme accuracy was necessary, the mercury thermometer was very much more convenient than the platinum thermometer. Mr. Burstall said the great convenience of the platinum thermometer lay in the fact that the scale could be read at a distance of many yards from the point where the temperature was being measured, and hence could be used in many places where it would be impossible to read a mercury thermometer. Mr. Blakesley considered that the author was somewhat bold to state that for general purposes it was never necessary to measure temperature to nearer than one-tenth of a degree. The author having replied, the Society adjourned till December 13.

Mathematical Society, November 14.—Major MacMahon, R.A., F.R.S., President, in the chair.—The President announced the death of Mr. E. H. Rhodes (elected June 10, 1875), which took place on the 1st inst.—The gentlemen, whose names were published in NATURE of October 31, were, after the ballot had been taken, declared duly elected on the Council for the ensuing session.—The President stated the reasons which had led Mr. M. Jenkins, after thirty years' tenure of the office, to resign his position of Secretary, and moved a vote of thanks to that gentleman for his "devoted services of thirty years" to the Society, and coupled with the vote the hope that his health might be improved by his retirement to the country. The vote was seconded by Mr. Kempe, F.R.S., and supported by Mr. S. Roberts, F.R.S., who had been connected with the Society almost from its inception. After the vote had been unanimously carried, Mr. Jenkins suitably thanked the Society and the speakers for their good wishes and appreciation of his services. The following papers were read or communicated: On the stability and instability of certain fluid motions (iii.), and on the propagation of waves upon the plane surface separating two portions of fluid of different vorticities, by Lord Rayleigh, Sec. R.S. The two earlier papers upon the subject of these communications are to be found in the Society's *Proceedings* (vol. xi., 1880, and vol. xix., 1887).—Determination of the volumes of certain species of tetrahedron without employment of the method of limits, by Prof. M. J. M. Hill, F.R.S. Proofs are first given of the propositions: (A) that it can be shown without dissection that symmetrically equal tetrahedra are equal in volume. (B) That two tetrahedra having a common base, and being the images of one another with regard to that base, are equal. (C) That a tetrahedron, in which the line joining the middle points of two opposite edges is perpendicular to those edges, can be bisected into two superposable tetrahedra by a plane through either of these edges and the middle point of the other. By means of (B) a tetrahedron of special form is constructed, such that a prism can be built up of this tetrahedron and two of its successive images. The volume of this species of tetrahedron is then known without employment of the method of limits. Calling it ABCD, its sides are expressible in terms of two parameters a, r as follows:

$$AC = a\sqrt{9 - 3r^2}, \quad AD = BC = 2a,$$

$$AB = BD = DC = a\sqrt{1 + r^2}.$$

By means of (C) two other types of tetrahedra, whose sides are expressible in terms of two parameters, are deduced from the tetrahedron ABCD. Also by a consideration of a special case of the tetrahedron ABCD, the volumes of two tetrahedra of definite shape, not included in the above-mentioned types, are determined.—An extension of Sylvester's constructive theory of partitions, by the President. In connection with this paper the President communicated a paper by Prof. Forsyth, F.R.S., entitled, "Some algebraic theorems connected with the theory of partitions.' The paper is concerned with a general method leading to the proof of some theorems required in Major MacMahon's investigations in the partitions of numbers. They depend upon the summation of terms selected from the series, which is the expansion of particular fractions, and the summation is effected algebraically.—On the evaluation of a certain dialytic determinant, by Mr. W. W. Taylor. In a paper read before the Society in March 1894, Prof. Elliott (the author) remarked: "It

is unfortunate for the simplicity of the argument of this paper that the property of such a determinant as Δ, that after division by its obvious factors $F(\rho, 1)$, $F(\rho, -1)$, it leaves a perfect square, is one which, as far as I know, direct algebraical methods have not yet supplied." This *lacuna* Mr. Taylor supplies.—Lieut.-Colonel Cunningham, R.E., communicated a criterion of 2 as a 16^{lc} residue, and added some remarks upon certain of Mersenne's numbers.—The following papers were taken as read: Notes on matrices, by Mr. J. Brill; certain general series, by Mr. F. H. Jackson; note on the representation of a conic by a linear equation, by Mr. J. Griffiths; on the representation of a number as a sum of two squares, by Prof. G. B. Mathews; researches in the calculus of variations: part vii., limiting conditions in multiple integrals; part viii., reduction of the problem of the discrimination of maxima and minima values in double integrals with variable limits to a new problem in single integrals, by Mr. E. P. Culverwell; a note on certain forms of the equation of normals to conic sections, by Mr. J. L. S. Hatton.

PARIS.

Academy of Sciences, November 18.—M. Marey in the chair.—Truffles (*Terfezia hanotauxii*) from Teheran, by M. Ad. Chatin. The characteristics of Persian truffles and their spores are described. The name *Terfezia hanotauxii* is given to these truffles as forming a new species. The most important characters are given for comparison of the other known species of Terfezia: *T. claveryi*, *T. boudieri*, *T. hafizi*, and *T. leonis*.—On a probably new element existing in the terbium earths, by M. Lecoq de Boisbaudran. The evidence relied upon is that of an absorption band at λ 487·7, which the author fails to connect with known elements.—A memoir, by M. A. Sarrat, on a demonstration of Fermat's theorem. Impossibility of the equation $a^n + b^n = c^n$ in whole numbers, was submitted to a committee.—A note of M. J. Laborde on the causes of the formation of hail was similarly disposed of.—Observations of the sun, made at Lyons Observatory (with the Brunner equatorial) during the second quarter of 1895, by M. J. Guillaume.—On the employment of punching and shearing as methods of testing metals, by MM. L. Bacte and Ch. Fremont. A machine, called by the authors an *élasticimètre*, is described by means of which indicator diagrams are obtained which show the actual character of the instantaneous stresses developed in the operations of punching and shearing. Special test-samples are not required, the machine is applied while the material is being worked up in the ordinary way.—On a power dynamometer specially applicable to physiological studies, by M. Charles Henry.—On the origin of atmospheric oxygen, by M. T. L. Phipson. The author recalls the results of his researches on this subject, and summarises them as follows: (1) In the most distant geological periods nitrogen formed, as now, the principal part of the earth's atmosphere. (2) The presence of free oxygen in this atmosphere is entirely due to vegetation. Primitive plants were the means by which oxygen was naturally supplied to the air. (3) Plants now living are, like those of geological times, essentially anærobic. (4) As the quantity of free oxygen in the atmosphere has gradually augmented, the anærobic cell has become modified into more or less ærobic forms (fungi, bacteria), and finally has become completely ærobic (in animal life). (5) The lowest unicellular algæ give, weight for weight, much more oxygen to the atmosphere than to the superior plants. (6) In proportion with the slow increase of the relative quantity of oxygen in the air, the cerebro-spinal nervous system, the highest characteristic of animal life, has become more and more complex.—Synthesis of methyleugenol. Constitution of eugenol, by M. Ch. Moureu. Allyl veratrol is synthetically formed and shown to be methyleugenol. It follows that eugenol is an allylguaiacol.—On the cholesterines of the cryptogams, by M. E. Gérard.—On the distribution of pectase in the vegetable kingdom and on the preparation of this diastaste, by MM. G. Bertrand and A. Mallèvre. Pectase may be regarded as of universal occurrence in the green plants. It is especially abundant in leaves, and probably spreads from the leaves to the other organs. The richness of certain leaves in pectase has permitted the preparation of this ferment.—Researches on the Tapidæ, by M. Piéri.—Study on the reproduction of wasps, by M. Paul Marchal.—On a morphological modification of species and on the heredity of acquired characters, by M. Rémy Saint-Loup.—On a disease of the sloe-tree contracted spontaneously by a maple, by M. Paul Vuillemin.—On the structure and optical properties of divers compact or earthy silicates, by M. A. Lacroix. The minerals studied, though apparently compact and earthy, are formed wholly or in part of a crystallised substance having many of the properties of mica.—On the optical isomorphism of felspars, by M. Fr. Wallerant.—Triassic ammonites from New Caledonia, by M. Edmond de Mojsisovics.—On the retting of flax and the microbe concerned, by M. S. Winogradsky.—On the use of viper's and adder's blood as antivenomous substances, by MM. C. Phisalix and G. Bertrand.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—A Manual of Physics: Dr. W. Peddie, 2nd edition (Baillière).—Thirteenth Annual Report of the Fishery Board for Scotland. Part 3. Scientific Investigations (Edinburgh, Neill).—Mechanics, Hydrostatics: R. T. Glazebrook (Cambridge University Press).—Cambridge Natural History. Vol. v. Peripatus, Myriapods, Insects: A. Sedgwick, F. G. Sinclair, and D. Sharp (Macmillan).—Molecules and the Molecular Theory of Matter: A. D. Risteen (Ginn, Boston).—On the Densities of Oxygen and Hydrogen, and on the Ratio of their Atomic Weights: Dr. E. W. Morley (Washington).—Elementary Inorganic Chemistry: Prof. A. H. Sexton, 4th edition (Blackie).—Earth-Knowledge: W. J. Harrison and H. R. Wakefield, Part 1, 9th edition (Blackie).—Food and its Functions: F. Knight (Blackie).—Minerals and how to Study them: E. S. Dana (Chapman).—Grundgesetze der Molekularphysik: T. H. Schwartze (Leipzig, Weber).—Sur l'Origine du Monde: H. Faye, troisième édition (Paris, Gauthier-Villars).—Essais sur la Philosophie des Sciences. Analyse-Mécanique: C. de Freycinet (Paris, Gauthier-Villars).—First Stage Mechanics: F. Rosenberg (Clive).—Observaciones de Precision con el Sextante, Conde de Cañete del Pinar (Madrid, R. Alvarez).—The Wild Fowl and Sea Fowl of Great Britain: A Son of the Marshes (Chapman).

PAMPHLETS.—Cantor Lectures on Commercial Fibres: Dr. D. Morris (Trounce).—An Account of the Smithsonian Institution (Washington).—The Exhibit of the Smithsonian Institution at the Cotton States Exposition, Atalanta, 1895 (Washington).—Christian Huygens: J. Bosscha (Leipzig, Engelmann).—The Common Crow of the United States: W. B. Barrows and E. A. Schwarz (Washington).

SERIALS.—Natural Science, December (Rait).—Longman's Magazine December (Longmans).

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